THE

LONDON

MECHANICS' REGISTER.

" But now let other themes our care engage,
" For lo! with modest, yet majestic grace,
" To curb imagination's lawless rage,
" And from within the cherished heart to brace,
" PHILOSOPHY appears. The gloomy race
" By indolence and moping fancy bred,
" Fear, discontent, solicitude, give place,
" And hope and courage brighten in their stead,
" While on the kindling soul her vital beams are shed."

BEATTIE.

VOLUME THIRD.

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PREFACE.

THE completion of our THIRD VOLUME imposes on us the gratifying duty of renewing our grateful acknowledgments to the Public, for the ample share of patronage with which our labours continue to be honoured, and which, while it conveys a satisfactory and flattering proof of the estimation in which our work is held by its numerous readers, affords the most powerful stimulus to unremitted and increased exertions on our part, to preserve the favourable opinion we have been so fortunate as to obtain.

The period is arrived when it would be as superfluous to adduce any arguments to prove the inestimable advantages resulting from the diffusion of scientific knowledge among the working classes of the community, as to shew the superiority of a fertile and highly cultivated country over an uncultivated wilderness. The experience of the last two or three years has established the fact beyond the power of refutation; and it is gratifying to observe that the unfounded opinions and prejudices of many well-meaning individuals, who either predicted the failure of any attempt at the dissemination of science among Mechanics, or anticipated evil consequences from the success of the experiment, have gradually yielded to conviction, and that a number of those who withheld their assistance from MECHANICS' INSTITUTIONS, or opposed their establishment, may now be ranked amongst the warmest supporters of these admirable seminaries of knowledge.

As demonstrative evidences of the accelerated force of the impetus which has been communicated to the mental faculties of the operative classes in the metropolis, we may advert to the increasing numbers who constantly crowd the ample Theatre of the LONDON MECHANICS' INSTITUTION, and to the avidity with which they peruse those numerous periodical publications of a scientific nature, which, in the present state of literature, they are enabled to purchase without inconvenience. That the same laudable spirit of inquiry is awakened throughout the kingdom, is proved by the almost universal establishment of provincial Mechanics' Institutions, and there can be no doubt that the ultimate increase of our national power and greatness, will be in exact proportion to the mass of intellectual energy thus roused from its slumbers, and brought into active and efficient operation.

The cheap scientific periodicals to which we have alluded, possess various degrees of merit, but all have co-operated in promoting the great object of Mechanics' Institutions—all have contributed, in a greater or less degree, to the diffusion of science among the working classes, and to the useful purpose of affording to the Mechanics an opportunity of communicating their ideas to the public. Of this advantage, our own experience enables us to state that they have availed themselves to a considerable extent, and have thus improved their own talents by imparting useful information to others.

It is not our province to speak of our own labours in the vineyard, or of the share we have had in forwarding the developement of latent intellect. Three volumes of our work are now before the bar of public opinion, and by that opinion, whether favourable or unfavourable, our merits or demerits must be appreciated. But if we may venture to confide in the unbiassed judgment of many individuals of acknowledged scientific and mechanical talent—if we may appeal to the unsolicited testimonies of approbation which we are in the constant habit of receiving from our numerous subscribers—and if, above all, we may consider the good opinion of **Dr. Birkbeck**, repeatedly expressed in the kind communications with which he has so frequently obliged us, as a criterion of the value of our unpresuming publication—we may, perhaps, be excused for preferring our claim to a portion of that patronage to which merit, however humble, is justly entitled.

To **Dr. Birkbeck**, the projector of Mechanics' Institutions, and the author of the great revivification of the human faculties, which has been for some time in active progress, we beg to offer our heartfelt thanks for his valuable contributions to our pages. To our other Correspondents, whose numerous and interesting communications have conveyed so much useful information to the public, our warmest gratitude is also due; and we need only add, that in the future conduct of our work, we shall endeavour to "*deserve*" a continuance of that "success" which "'tis not in mortals to *command*."

BIOGRAPHICAL MEMOIR

OF

SIR HUMPHRY DAVY, BART.

President of the Royal Society, &c. &c.

THE brilliant discoveries of the distinguished individual whose Portrait is prefixed to the present Volume, have placed him in the first rank of those eminent men whose labours have shed an unfading lustre on the literary and scientific annals of our own country, and have conferred incalculable benefits on mankind at large. Chemistry, the science to which the energies of his powerful mind have, in an especial manner, been directed, is rapidly adapting itself to almost every purpose of civilized life; and as its valuable properties become more generally understood, the debt which is owing to those who developed them, will be more readily appreciated and acknowledged.

Sir Humphry Davy was born December 17, 1779, at Penzance in Cornwall; and a contemporary biographer has observed, that there are many natives of that place who remember his poems and verses, written at the early age of nine years. At that period his mind seems to have received a bias in favour of poetry, which he continued to cultivate till his fifteenth year, when he became the pupil of Mr. (since Dr.) Borlase, of Penzance, a very ingenious surgeon, and accomplished man, intending to prepare himself for graduating as a physician at Edinburgh. Conscious of uncommon powers, and resolved to attempt a nobler career than circumstances appeared to promise, or his friends could expect, Mr. Davy laid down for himself a plan of education, which embraced the circle of the sciences. By his eighteenth year he had acquired the rudiments of botany, anatomy, and physiology, the simpler mathematics, metaphysics, natural philosophy, and chemistry.

But CHEMISTRY soon arrested the whole of his attention; for he at once saw that this science offered the best field for the exertion of talent. Having made some experiments on the air disengaged by sea-weeds from the water of the ocean, which convinced him that these vegetables produce the same effect in purifying the air dissolved in water, which land vegetables do in the atmosphere, he communicated them to Dr. Beddoes, who had, at that time, circulated proposals for publishing a journal of philosophical contributions from the west of England. This produced a correspondence between Dr. Beddoes and Mr. Davy; in which the doctor proposed that Mr. Davy, who at this time was only nineteen years of age, should suspend his plan of going to Edinburgh, and take a part in experiments, which were then about to be instituted at Bristol, for investigating the medical powers of factitious airs; to which proposal Mr. Davy consented, on condition that he should have the uncontrolled superintendence of these experiments.

About this time he became acquainted with Davies Gilbert, Esq. M. P., a gentleman of high scientific attainments, with whom he formed a friendship which has continued to the present time. Mr. Davy consulted with Mr. Gilbert on his plan of study, and stated his attachment to chemistry; when that gentleman judiciously advised him to pursue his career in that science. With Dr. Beddoes, Mr. Davy resided for a considerable time, and was constantly employed in new chemical investigations; being occasionally assisted by his friend, Mr. W. Clayfield, a very respectable and amiable gentleman of Bristol, who was ardently attached to chemical pursuits. Here he discovered the respirabilty of nitrous oxide, and made a number of laborious experiments on gaseous bodies, which he afterwards published in his "Researches, Chemical and Philosophical;" a work that was universally well received by the chemical world, and created a high reputation for its author, at that time only twenty-one years of age. This led to his introduction to Count Rumford, and to his being elected Professor of Chemistry in the Royal Institution, about which time he removed to the metropolis, and gave up all thoughts of the medical profession.

In 1802, he commenced a course of lectures before the Members of the Board of Agriculture, which were highly approved. In the following year he was elected Fellow of the Royal Society; in 1805, a Member of the Royal Irish Academy; and, besides corresponding with the most eminent scientific characters on the continent, was on terms of friendly intercourse with Banks, Cavendish, Wollaston, Babington, and others equally celebrated.

In 1806, he was appointed Secretary of the Royal Society; having, about this time, made what is scientifically termed "one of the most brilliant discoveries of modern times." This was the decomposition of the two *fixed* alkalies, *potash* and *soda*. He found them, in direct refutation of an adopted hypothesis, to consist of a *metallic base*, blended with a large quantity of *oxygen*. The metals thus discovered, were called *potassium* and *sodium*. In 1808, he received a prize from the French Institute; and, in 1810, was presented with the honorary degree of LL.D. by the Provost and Fellows of Trinity College, Dublin. In the following year, the Prince Regent was pleased to confer upon him the honour of Knighthood; being the *first* individual who received that honour at his Royal Highness's hands.

But the great discovery with which his name is more especially associated, and by which alone he would have ensured the gratitude of posterity, is, "THE SAFETY LAMP," for preventing those dreadful occurrences of death and mutilation, supposed to be inseparably connected with the miner's dreary occupation. The following facts connected with this invaluable instrument are interesting, as many of our readers, who are acquainted with the mode of constructing a *Davy*, as it is technically called, may be unacquainted with the history of its invention.

The researches which led to the invention of the safety lamp for coal mines, which has been so generally and successfully adopted throughout Europe, may justly be considered as the most important of all Sir Humphry Davy's labours, since they enabled him to provide the means of preserving many valuable lives, and preventing a series of accidents, more dreadful than even death itself. The frequency of such accidents, arising from the explosion of *fire-damp*, or the inflammable gas of coal mines, mixed with atmospheric air, occasioned the formation of a committee at Sunderland, for the purpose of investigating the causes of these calamities, and of endeavouring to discover and apply a preventive. Sir Humphry received an invitation from Dr. Gray, one of the members of the committee; in consequence of which he went to the north of England, and visiting some of the principal collieries in the neighbourhood of Newcastle, soon convinced himself that no improvement could be made in the mode of ventilation, but that the desired preventive must be sought in a new method of lighting the mines, free from danger, and which, by indicating the state of the air in the part of the mine where inflammable air was disengaged, so as to render the atmosphere explosive, should oblige the miners to retire till the workings were properly cleared.

The common means then employed for lighting the dangerous part of the mines, consisted of a steel wheel revolving in contact with flint, and affording a succession of sparks: but the apparatus always required a person to work it, and was not entirely free from danger. The fire-damp was known to be *light carburetted hydrogen gas;* but its relations to combustion had not been examined. It is chiefly produced from what are called blowers, or fissures, in the broken strata near dikes. Sir Humphry made various experiments on its combustibility and explosive nature; and discovered that the fire-damp required a very strong heat for its inflammation; that *azote* and *carbonic acid*, even in very small proportions, diminished the velocity of the inflammation; that mixtures of the gas would not explode in metallic canals or troughs, where their diameter was less than one-seventh of an inch, and their depth considerable in proportion to their diameter; and that explosions could not be made to pass through such canals, or through very fine wire sieves, or wire gauze.

The consideration of these facts led Sir Humphry to adopt a lamp, in which the flame, by being supplied with a limited quantity of air, should produce such a quantity of *azote* and *carbonic acid*, as to prevent the explosion of the fire-damp, and which, by the nature of its apertures for giving admittance and egress to the air, should be rendered incapable of communicating any explosion to the external air. These requisites were found to be afforded by lanterns, of various constructions, supplied with air by canals of small diameter, or from apertures covered with wire-gauze placed below the flame, through which explosions cannot be communicated; and having a similar covering at the upper part, for carrying off the de-oxygenized air. Sir Humphry soon afterwards found that a constant flame might be kept up from the explosive mixture issuing from the apertures of a wire-gauze sieve. He introduced a very small lamp in a cylinder, made of wire-gauze, having more than six thousand apertures in the square inch. He closed all the apertures except those of the gauze, and introduced the lamp, burning brightly within the cylinder, into a large jar, containing several quarts of the most explosive mixture of gas from the distillation of coal, and air; the flame of the wick instantly disappeared, or rather was lost, for the whole of the interior of the cylinder became filled with a feeble but steady flame of a green colour, which burned for some minutes, till it had entirely destroyed the explosive power of the atmosphere. This discovery led to a most important improvement in the lamp, divested the fire-damp of all its terrors, and applied its powers, formerly so destructive, to the production of a useful light. Some minor improvements, originating in Sir Humphry's researches on the nature of flame, were afterwards effected. Experiments of the most satisfactory nature were speedily made, and the invention was soon generally adopted.

It should be mentioned, that the coal-owners of Tyne and Wear evinced their gratitude by presenting to Sir Humphry a service of plate, worth 2000*l.*; and that the few catastrophes which have since been recorded, are attributable solely to negligence in the use of his lamp.

Marks of distinction from almost every foreign institution, have successively shewn the estimation in which Sir Humphry is held; and in 1818, he was created *a Baronet of the kingdom.* His travels in Europe have been directed, chiefly, to the investigation of volcanic phenomena—to the instruction of miners in the use of his safety-lamp—to the examination of the Herculanean MSS.—and to the remains of the chemical arts of the ancients. The manuscripts he found to have been cemented by a substance generated in fermentation; but very few were soluble by the composition applied to them. Curiosity was anxiously excited amongst the learned, when this visit was announced; and from a recollection of the prodigious services which chemistry had rendered to the arts, very flattering results were anticipated from the labours of so eminent a character. Time, however, had rested his consuming hand too long upon these esteemed relics; and though partial success attended Sir Humphry's endeavours to restore them, it served but to confirm the value of the treasures thus lost for ever to the curious. The classic spots to which he resorted were, the baths of Titus and of Livia, and the ruins of Rome and Pompeii. Canova furnished him with pigments, which had been deposited in vases, and discovered during the excavations, for comparison with such remnants of paintings as remained in the above-named places.

Shortly after his return to England, in 1820, the chair of the Royal Society became vacant by the death of that distinguished character, SIR JOSEPH BANKS; and to it, notwithstanding the opposition of a few individuals, who nominated Lord Colchester, Sir Humphry Davy was elected by a very great majority; DR. WOLLASTON, a gentleman of extraordinary knowledge, and uncommon modesty, declining to appear as a competitor, when apprised of his friend's nomination. In this elevated and honourable situation, SIR HUMPHRY has since pursued his splendid career with unabated ardour, and by his laborious researches into the mysterious operations of nature, has added many important discoveries to those which he had previously communicated to the world.

Sir Humphry Davy has attained his present exalted rank in life by innate talent, rather than by any fortuitous circumstances arising from high birth, or paternal inheritance. The following valuable works, of which he is the author, attest the debt which the world owes to his great mind and meritorious exertions:—

Chemical and Philosophical Researches, chiefly concerning Nitrous Oxide and its Respiration. 1800.

A Syllabus of a Course of Lectures on Chemistry. 1802.

A Discourse, introductory to a Course of Lectures on Chemistry. 1802.

Electro-Chemical Researches on the Decomposition of the Earths; with Observations on the Metals obtained from Alkaline Earths, and an Amalgam procured from Ammonia. Lecture on a Plan for improving the Royal Institution, and making it permanent. 1810.

Elements of Chemical Philosophy. 1812.

Elements of Agricultural Chemistry, in a Course of Lectures before the Board of Agriculture. 1813.

Practical Hints on the Application of Wire-gauze to Lamps for preventing Explosions in Coal-mines.

The papers published by Sir Humphry in the "Transactions of the Royal Society," are highly interesting. The following chronological series will, however, best shew their number and value:—

Account of some Galvanic Combinations formed by the Arrangement of single Metallic Plates and Fluids, analogous to the new Galvanic Apparatus of Mr. Volta.

Account of some Experiments and Observations on the Constituent Parts of certain Astringent Vegetables, and on their Operation in Tanning.

An Account of some Analytical Experiments on a Mineral Production from Devonshire, consisting principally of Alumine and Water.

On a Method of Analyzing Stones, containing fixed Alkali, by means of the Boracic Acid.

The Bakerian Lecture on some Chemical Agencies of Electricity.

The Bakerian Lecture on some new Phenomena of Chemical Changes produced by Electricity, particularly the Decomposition of the fixed Alkalies, and the Exhibition of the new Substances which constitute their Basis, and on the general Nature of Alkaline Bodies.

The Bakerian Lecture; an Account of some New Analytical Researches on the Nature of certain Bodies, particularly the Alkalies, Phosphorus, Sulphur, Carbonaceous Matter, and the Acids hitherto undecompounded; with some general Observations on Chemical Theory.

New Analytical Researches on the Nature of certain Bodies, being an Appendix to the Bakerian Lecture for 1808.

The Bakerian Lecture for 1809, on some new Electro-Chemical Researches on various Subjects, particularly the Metallic Bodies from the Alkalies and the Earths, and on some Combinations of Hydrogen.

Researches on the Oxymuriatic Acid, its Nature and Combinations, and on the Elements of Muriatic Acid; with some Experiments on Sulphur and Phosphorus, made in the Laboratory of the Royal Institution.

The Bakerian Lecture, on some of the Combinations of Oxymuriatic Gas and Oxygen Gas.

On some Combinations of Phosphorus and Sulphur, and on some other subjects of Chemical Inquiry.

On a new Detonating Compound.

Some further Observations on the same.

Some Experiments and Observations on the Substances produced in different Chemical Processes on Fluor Spar.

An Account of some new Experiments on the Fluoric Compounds; with some Observations on other Objects of Chemical Inquiry.

Some Experiments and Observations on a new Substance, which becomes a violet-coloured Gas by Heat.

Further Experiments and Observations on Iodine.

Some Experiments on the Combustion of the Diamond, and other Carbonaceous Substances.

Some Experiments and Observations on the Colours used in Painting by the Ancients.

Some Experiments on a Solid Compound of Iodine and Oxygen, and on its Chemical Agencies.

On the Action of Acids on the Salts usually called Hyperoxymuriates, and on the Gases produced from them.

On the Fire-Damp of Coal Mines, and on Methods of Lighting the Mines so as to prevent Explosion.

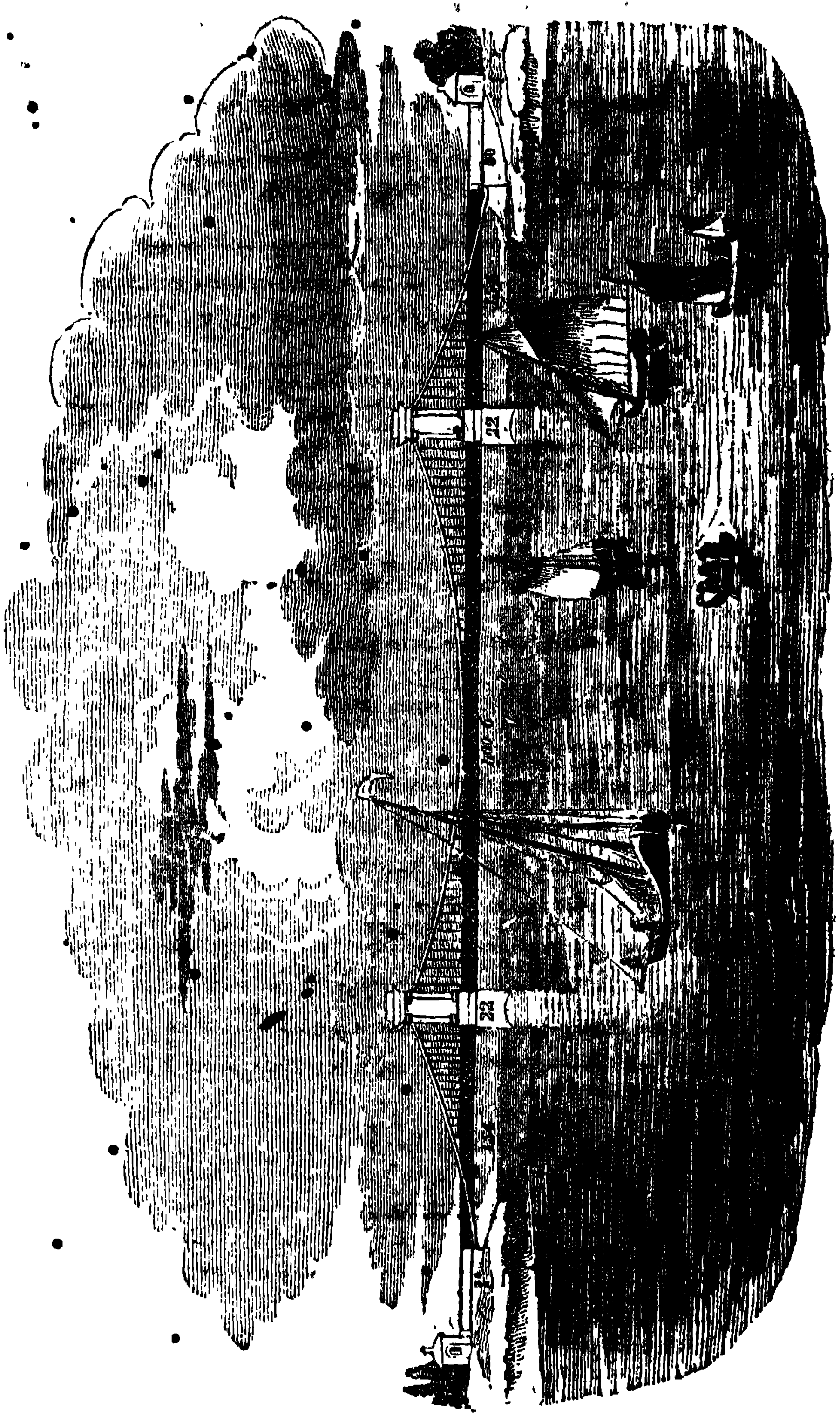
An Account of an Invention for giving Light in explosive Mixtures of Fire-Damp in Coal Mines, by consuming the Fire-Damp.

THE LONDON

MECHANICS' REGISTER.

"Knowledge is Power."—Lord Bacon.

No. 57.] SATURDAY, OCTOBER 29, 1825. [Price 3*d*.



VIEW OF THE NEW BRIDGE OF SP ON AT HA ERSMITH

NEW BRIDGE OF SUSPENSION AT HAMMERSMITH.

To the Editor of the Mechanics' Register.

1, Lower Mall, Hammersmith,
October, 1825.

Sir,—Notwithstanding the delay which has taken place, owing to unforeseen circumstances, in the communication of the accompanying plan and description of the intended Bridge of Suspension, at Hammersmith, I flatter myself the readers of your intelligent miscellany will be gratified by the perusal of the particulars which I feel great pleasure in transmitting for their information.

The plan is a copy which I made some time since from the original drawing, and from the subjoined description, given by Mr. Clark, the engineer, you will find it is a correct one. The elevation of the road-way of the bridge is so much above the level of the Hammersmith high road, that, when complete, it will command a delightful view of Chiswick and Hammersmith Terrace, looking up the River; and likewise a very pleasing and picturesque prospect in the opposite direction, commanding a view of Putney, with a partial view of Fulham Church, and the beautiful grounds which were lately the site of Brandenburg House. In a south-westerly direction, the view will extend over the village of Barnes, as far as Richmond. Part of the country looking over Wormholt Scrubbs and Hampstead, will also be included in the view.

The new road from the bridge will lead directly to Barnes Terrace, Mortlake and Richmond, saving, in point of distance, about a mile and a half to the latter place. Thus the new bridge will afford advantages of material importance to persons travelling from London to either of the above places, as it will have the effect of causing a considerable saving of time, as well as of wear and tear of carriages, cattle, &c. It will also open a much nearer communication with the great roads leading to Portsmouth, Plymouth, Chichester, &c. &c.

You will excuse the detail of these particulars, as I was anxious to give you all the information I could respecting the situation of the intended bridge. The workmen are proceeding rapidly with its construction: one of the piers is already raised above the level of the road-way, and it is universally allowed that the principal masons, Messrs. Garrick and Lumsden, complete their work, as they go on, in a masterly and workman-like manner. The builders, who have the contract for completing the work, are Messrs. G. S. and W. Bird. That the intended Bridge, when completed, may prove advantageous to the Hamlet of Hammersmith is the sincere wish of your's, respectfully,

H. MOTE.

DESCRIPTION OF THE BRIDGE.

THE Engraving is a correct representation of the Bridge of Suspension at Hammersmith, from the design of Mr. W. Tierney Clark, Engineer, and now building under his direction. The principal Piers in the River are built of Stone, and from low-water, up to the road-way, is plain, rusticated masonry. Above the level of the road-way is a sub-plinth, supporting pilasters, 30 feet high. These, as well as the other materials of masonry, on each side, are connected together by an arch, surmounted by an entablature of the purest Tuscan order; and, when finished, will have the appearance of a triumphal arch.

The chains are composed of flat bars of iron, 5 inches deep, 1 inch thick, and 10 feet in length; connected together by side-plates, through which a hole is drilled, as well as through the ends of the links, for receiving a screw-bolt that connects the whole together. The four main chains, for supporting the road-way, are composed of six links, side by side, with their intermediate plates. On each side of the Pier there are four of these chains; two main chains, one immediately above the other, and two small chains, composed of three links and plates, side by side, and one over the other. From the upper chains, as well as the lower, are fixed vertical bars, for supporting the platform that forms the road and footpaths. All the chains are to pass over a strong cast-iron frame, with rollers and moving plates, to allow for the variation of their contraction and expansion. The chains are then firmly secured on each shore by means of strong fixture-piers, built of stone and brick, and above 900 tons weight. At the back of the piers is a strong cast-iron plate, for adjusting the chains.

The following are the dimensions of the Bridge:—

Centre opening, in the clear, 400 feet 6 inches; thickness of the piers 22 feet each. Side-opening, on the Middlesex shore, 154 feet; and the same on the Surrey side. Depth of the fixture-piers, 30 feet each.

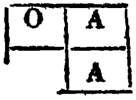
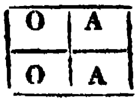
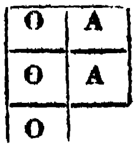
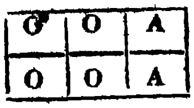
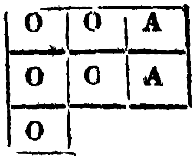
LONDON MECHANICS' INSTITUTION.

MR. COOPER'S FOURTH LECTURE ON CHEMISTRY.

OTHER COMPOUNDS OF AZOTE WITH OXYGEN—TABLE OF THE FIVE COMPOUNDS—HYPO-NITROUS ACID—ITS EFFECTS, AS A SUPPORTER OF COMBUSTION—NITROUS-ACID GAS—ITS FORMATION—ITS ABSORPTION BY WATER—FORMATION OF NITRATES AND NITRITES, SULPHATES AND SULPHITES, &c.—NITRIC ACID—PROCESSES EMPLOYED IN ITS MANUFACTURE—MODE OF PURIFYING IT, &c.

FRIDAY, OCTOBER 21ST.

Mr. COOPER commenced this evening's lecture by observing, that, as he had already engaged the attention of the members with the consideration of two of the compounds, of *azote* with *oxygen*, he purposed, in his present discourse, to continue his examination of the compounds of those gases, and to point out the material difference existing between those which he was now about to illustrate, and those of which he had spoken in his last lecture. The compounds, which remain to be examined, all possess *acid properties*. It has been seen, by previous experiments, that *nitrous gas*, when mixed in any proportion with *atmospheric air*, exhibits the properties of an acid; and the first compound we shall speak of, which developes this characteristic, is that which possesses the least quantity of *oxygen* of the three, viz., *hypo-nitrous acid*; containing, as its name imports, less *oxygen* than *nitrous-acid gas*. Mr. Cooper here referred to the large diagram-board, on which were delineated the following figures; exhibiting, at one view, the whole of the compounds of *azote* with *oxygen*, and the relative proportions, by volume, in which these two constituents combine to produce them:—

			Oxygen.		*Azote.*
1.	*Nitrous Oxide*		100	+	200
2.	*Nitrous Gas*		200	+	200
3.	*Hypo-Nitrous Acid*		300	+	200
4.	*Nitrous Acid*		400	+	200
5.	*Nitric Acid*		500	+	200

Of the various compounds represented in the above diagram, the two first, viz., *nitrous oxide* and *nitrous gas*, have been already described. To form the third compound, which is now under consideration, it is only necessary to mix azote with oxygen, in the proportion of two volumes of the former to three of the latter; and, as nitrous gas consists of two volumes of azote with two of oxygen, it is evident that, by adding one volume of oxygen to four of nitrous gas, the *hypo-nitrous acid* will be formed. As this gas, and the remaining compounds of azote with oxygen, are rapidly absorbed by water, they cannot be conveniently combined over that fluid, for absorption takes place immediately on their formation; and it is, therefore, necessary to effect their combination in a vessel exhausted of air.

Mr. Cooper accordingly abstracted the air from a cylindrical glass vessel, and having passed up a quantity of *nitrous gas* into another vessel, standing over water in the pneumatic trough, he transferred the gas into the exhausted vessel, and adding, in a similar manner, the requisite proportion of *oxygen*, a dense red vapour was instantly formed by their union. This vapour is the *hypo-nitrous acid*, and, upon opening the vessel under water, it will be found that a considerable condensation of volume results from the combination of the additional portion of oxygen with nitrous gas. This was shewn experimentally, and the water, upon being allowed to enter the vessel, immediately occupied about two-thirds of its interior. Into the upper part of the vessel, which remained full of the hypo-nitrous acid, the Lecturer introduced a slip of litmus paper, which was instantly reddened, thus demonstrating the formation of an *acid* during the combination of oxygen with nitrous gas, in proportions already mentioned.

The action of combustible bodies on this gas is somewhat analagous to the effect of combustion on the compounds previously examined, as some combustible substances burn in it, while others are extinguished. A lighted taper immersed in it continues to burn, and phosphorus also; but sulphur is instantly extinguished, and charcoal burns with a dull feeble light. To shew these effects, a large vessel was exhausted, and afterwards filled with *hypo-nitrous acid*, into which the Lecturer first put a lighted taper, which burnt in the red vapour with considerable brilliancy, though, in nitrous gas, it refuses to burn. It appears, therefore, that the combustion of the taper is supported, in consequence of this gas containing more oxygen than nitrous gas. *Phosphorus*, in a state of ignition, was then introduced into the gas, when it burnt with great rapidity and splendour, for a short time, when the vessel became filled with a dense white vapour, resulting from the formation of *phosphoric acid*, by the union of the phosphorus with the oxygen of the gas, while its azote was set at liberty. The effects of hypo-nitrous acid gas on ignited sulphur or charcoal, are so exactly analagous to those produced by nitrous gas, that it is unnecessary to exhibit them.

The next compound to which the Lecturer adverted, was *nitrous acid*, which contains more oxygen than the hypo-nitrous acid, as it consists of two volumes of *azote* combined with four of *oxygen*. The chemical combination which results from the mixture of the two constituents in these proportions, causes so immense a condensation, and the compound possesses such a rapacity for moisture, that it is difficult to ascertain its specific gravity. Mr. Cooper here directed the particular attention of his hearers to the diagram represented above, and went regularly through the series of compounds formed by the union of *oxygen* with *azote*, pointing out the relative proportions, in which these constituents unite, to constitute the various substances which result from their combination. Nothing, he observed, can afford a more satisfactory demonstration, of the doctrine of definite proportions, than these combinations of *azote* with *oxygen*.

When speaking, a few evenings since, of the employment of *nitrous gas*, for the purposes of eudiometry, he had stated that atmospheric air may be made to take up more or less of this gas, according to circumstances Now it is evident that more oxygen will combine with nitrous gas, when brought into contact with it in large than in small quantities; and, in consequence of different modes of operation, the degree of condensation has been differently stated by different chemists. Thus, Mr. Dalton operated with small tubes, and M. Guy Lussac with wide ones; and, under these circumstances, different portions of oxygen were absorbed; in the one case forming nitrous acid, and in the other, hypo-nitrous acid, according to the degree of rapidity with which the gases combined.

Nitrous acid possesses but few properties which it is necessary to particularize; but, as it produces different solutions, according to the different proportions in which it unites with water, this is a point of considerable importance to the manufacturers of nitrous acid. Now, if a quantity of nitrous gas, and, afterwards, the requisite proportion of oxygen, be admitted into a vessel, *nitrous acid gas* will be formed, as before. If a small quantity of water be then introduced and agitated, in contact with the acid, the whole of the vapour will be absorbed. Mr. Cooper exhibited this effect; and it was seen that the red vapours entirely disappeared, when agitated with water. Another portion of oxygen was then introduced, when the red vapours re-appeared, and were again absorbed, upon shaking the vessel. We may thus go on supplying the nitrous gas with oxygen, till the whole of the former has entered into combination, and the small quantity of liquid will remain strongly impregnated with the acid vapours. Thus, by continuing the operation, for a considerable length of time, we shall obtain a highly concentrated solution of the gas in water; and this is, in fact, the *liquid nitrous acid* sold in the shops. The colour of this liquid varies, according to the quantity of water with which it is diluted. That which the Lecturer had formed in the glass vessel was, evidently, of a light-blue colour; but it assumes a green, yellow, or orange-colour, in proportion to the quantities of water and nitrous gas which enter into its composition.

Mr. Cooper here observed, that different classes of *salts* are formed by the combination of *acids* with *alkalis*, or *metallic bases*; and, alluding to the acids at present under consideration, he explained the difference between *nitrates* and *nitrites*. Some difference of opinion has indeed prevailed as to the existence of such salts as *nitrites*; Berzelius maintaining the affirmative, while other chemists have denied the fact. The difference between *nitrates* and *nitrites*, as well as *sulphates* and *sulphites*, may be explained as follows:—When *sulphuric acid* enters into combination with an alkali or a base, the resulting salt is a *sulphate*, but *sulphurous acid*, under similar circumstances, forms a *sulphite*. In like manner, *nitric acid*, by combining with an alkali, &c., produces a *nitrate*, while *nitrous acid*, if it be capable of similar combinations, will form *nitrites*. It may therefore be stated, once for all, as a general rule, that acids terminating in IC, as sulph*uric*, carbon*ic*, nitr*ic*, &c., form sulph*ates*, carbon*ates*, nitr*ates*, &c. while those which end in OUS, as phosphor*ous*, sulphur*ous*, nitr*ous*, form phosph*ites*, sulph*ites*, nitr*ites*, &c.

The compound which remains to be illustrated, and the last of those formed by the union of *azote* with *oxygen*, is *nitric acid*; consisting, as appears by the preceding diagram, of two volumes of *azote* combined with five of *oxygen*. The first proof that nitric acid is so constituted, was furnished by Mr. Cavendish, who produced this acid by passing the electric spark for a considerable time through a confined portion of atmospheric air. Mr. Cooper elucidated the mode in which this experiment was performed, by pointing out two vessels of mercury which stood near the electrical machine. In these vessels were inserted the legs of a syphon-formed tube, of glass; both the legs being nearly filled with mercury, but leaving, at the upper part or bend of the syphon, a space occupied with atmospheric air. The prime conductor of the electrical machine being placed in contact with the mercury in one of the vessels, a few sparks were passed through the tube, to shew the method of performing the experiment; and Mr. Cooper stated, that Mr. Cavendish continued this operation, as often as he could, during a whole month, in an apparatus somewhat modified, at the end of which time, he found that the air had undergone a change, accompanied with considerable condensation; and he was enabled to ascertain the exact quantities of oxygen and azote that had united to form the substance which resulted. By its effect on litmus paper, it was ascertained to be an *acid*, and by the addition of *potash*, Mr. Cavendish obtained *nitrate of potash*.

Now, it must be evident, that either by the condensation of the requisite volumes of azote and oxygen, or by subjecting atmospheric air to electricity, only a small quantity of *nitric acid* could be obtained; and, as this is an article of great utility, and for which there is a large demand, some more expeditious mode of preparing it is essentially necessary. This is accomplished by the chemical action of *sulphuric acid* on *nitrate of potash*. The quality of the nitric acid produced by this process, depends on the quantity of sulphuric acid employed. For the orange-coloured liquid, the *oil of vitriol* may be used in the proportion of about half the weight of the *sulphate*, or 60 parts of the former to 100 of the latter. But to obtain nitric acid, 96 parts of sulphuric acid should be added to

100 parts of nitrate of potash. The two substances are put into a retort, and distilled over into another vessel. Mr. Cooper exhibited this operation by placing the requisite proportions of the two ingredients in a glass retort, the neck of which communicated with another glass vessel, into which the product was distilled, and the process was accelerated by the application of heat to the retort.

Mr. Cooper here illustrated the manufacture of *nitric acid* on a large scale, by directing the attention of the members to an apparatus which stood on the floor between the lecture-table and the iron railing before it. This apparatus consisted of a range of large earthen vessels, communicating with each other by means of a series of tubes luted to the mouths of the jars. In the first of these vessels, the *salt-petre* and *sulphuric* acid are placed, and the gas or vapour generated by the distillation of the mixture passing successively into the other vessels, which contain water, the water in the first receiver becomes nearly a saturated solution of nitric acid, while the others absorb the gas which is not taken up by the water in the first vessel. When the fluid in this vessel is sufficiently saturated, it is removed, and its place occupied by the second; and another vessel of water being placed at the extremity of the range, the process is renewed. Manufacturers who adopt the process already described, generally employ a large cast-iron vessel to hold the sulphuric acid and salt-petre, with a stone head to it, formed like that of an alembic. But when we consider the effects of sulphuric acid on the metal, it must be evident that the gas cannot be procured in a pure form when iron vessels are used in the process. It is therefore better to employ vessels of stone-ware to contain the ingredients which are to be operated upon. Mr. Cooper proceeded to observe, that the apparatus before the audience worked very well with 40lbs. of *salt-petre*, to which he generally added about 36lbs. of *oil of vitriol*. By applying his hand to the vessel containing these substances, he could ascertain the completion of the operation, as it became cold when there was no more acid distilling over. The residuum is a substance known to many of the members, and is called *sal nixum*, which, in some instances, is ladled out, and in others allowed to grow cold, when the vessel is inverted, and the salt tumbles out in cakes. The small glass apparatus on the lecture-table in which the process is now proceeding, will exemplify the nature of the operation, and the larger series of vessels is only introduced for the purpose of shewing more fully the manner in which nitric acid is prepared for various processes in the arts. The vapours which were at this time distilling over in the glass apparatus possessed a slight orange tint, which the Lecturer observed, would change as the process proceeded.

Other processes are adopted in cases where it is necessary to obtain *nitric acid* in a very pure state for chemical experiments. The apparatus for elucidating these processes had been previously fitted up in the recess on the right of the Lecturer, which is usually closed with folding-doors corresponding with those at the opposite end of the platform, at which the President, the Lecturer, &c. enter the theatre. In one of the methods alluded to, the nitrate of potash is inclosed in a large vessel of green glass, and the sulphuric acid is carefully introduced through a long tube, to avoid soiling the neck of the vessel. The heat of a sand-bath is applied to the ingredients, and the gas and vapour is distilled into proper receivers. The other apparatus was of a more economical description, the ingredients being placed in a stone vessel, also heated by a sand-bath; the top of this vessel is luted down, and connected with a stone worm contained in another vessel, also of stone, through which the process of distillation is carried on as before.

Nitric acid, as sent out by the manufacturers, is very impure, being generally contaminated with *sulphuric acid*, and very often with a considerable quantity of *muriatic acid*. To determine whether nitric acid is sufficiently pure for chemical purposes, it must be largely diluted with distilled water; and if it exhibits a milky appearance on adding to it a solution of *silver*, the presence of *muriatic acid* is indicated, which, by uniting with the oxide of silver, forms an insoluble milky precipitate. If, on the other hand, a similar appearance results from the addition of any of the salts of *barytes* to the diluted nitric acid, it contains a portion of *sulphuric acid*. Mr. Cooper applied these tests to some *nitric acid* in the manner described, and it was proved to be free from *sulphuric*, but not from *muriatic acid*.

It almost invariably occurs in the preparation of *nitric acid*, that it contains a considerable mixture of *nitrous gas*, by which its orange-colour is occasioned. It may, however, be purified by distillation with a fresh portion of *nitre* and a *salt of silver*. When the sulphuric and muriatic acids are got rid of, the nitrous gas may be extricated by exposing it to a gentle heat, or about 212° Fah., the heat of boiling water.

To obtain very pure *nitric acid*, perfectly pure crystals of nitre must be selected, and care must be taken that the sulphuric acid is also free from impurity. The acid will then be only contaminated with *nitrous gas*, which is easily abstracted from it, as the gas will fly off at the temperature of 212°, and leave the acid in a pure state.

As the *nitric acid*, prepared for different purposes in the arts, is always a mixture of the acid with certain definite quantities of *water*, it is of importance to the purchaser to know how to ascertain its strength. Water is much cheaper than the acid, and affords an inducement to the manufacturer to add rather too much of it. A method of exactly ascertaining its strength is therefore an object of consequence to the consumer, who ought to know the quality of the article he is purchasing. For instance, the kind of nitric acid employed by *brass-founders*, and which is called Brass-founders' aqua-fortis, is generally very dilute; and in the operation called *picking*, the workman frequently finds the acid fail, from not being sufficiently concentrated. It is mixed with substances which communicate *acidity* to it, but not the kind of acidity which the brass-founder wants. It should, therefore, be re-distilled, as before directed, to purify it from sulphuric and muriatic acid; and by observing how much *marble* a given quantity will dissolve, the exact strength of the nitric acid may be ascertained.

To *water-gilders*, who use a considerable quantity of this article, the same precaution is necessary; and to a third class, viz. *Dyers*, who employ it on a large scale, in making solutions of tin, it is particularly important that they should know how much acid they are paying for.

Mr. Cooper then remarked, that to shew these processes would occupy too much time, on the present occasion, particularly, as they would be explained when he came to speak of the processes in the arts and manufactures. He should, therefore, conclude, by observing that, in his next lecture, he should take into consideration the combinations of *azote* with *chlorine* and *iodine*.

Dr. BIRKBECK then announced to the Members that, agreeable to the notice given, on the preceding Friday, the LIBRARY OF CIRCULATION would be opened to the Members on the following Tuesday. The Rules and Regulations for conducting it would be hung up in the Reading Room, and a written Catalogue would be laid on the table, till printed Catalogues could be prepared for the Members. The worthy President added, that, as the number of Members now amounted to 1,800, considerable difficulty must arise in supplying the demand, if all the Members at once should wish to avail themselves of the opportunity. Every endeavour would, however, be made to obviate any inconvenience that might occur, and to furnish them with the books that might be applied for.

Dr. BIRKBECK also stated that, in consequence of the great gratification experienced by the Members at the FIRST ANNIVERSARY DINNER, it had been determined that the approaching Anniversary should be celebrated in a similar manner, by a Dinner, at the Crown and Anchor Tavern, on Friday, the 2d of December next; for which purpose, Tickets, 6s. 6d. each, might be obtained, either of the Secretary, or of any Member of the Committee of Management.

This communication was received with loud acclamations, and the crowded assembly then adjourned.

LECTURE FOR NEXT WEEK.

Friday, October 28th, Mr. Cooper's Sixth Lecture on Chemistry.

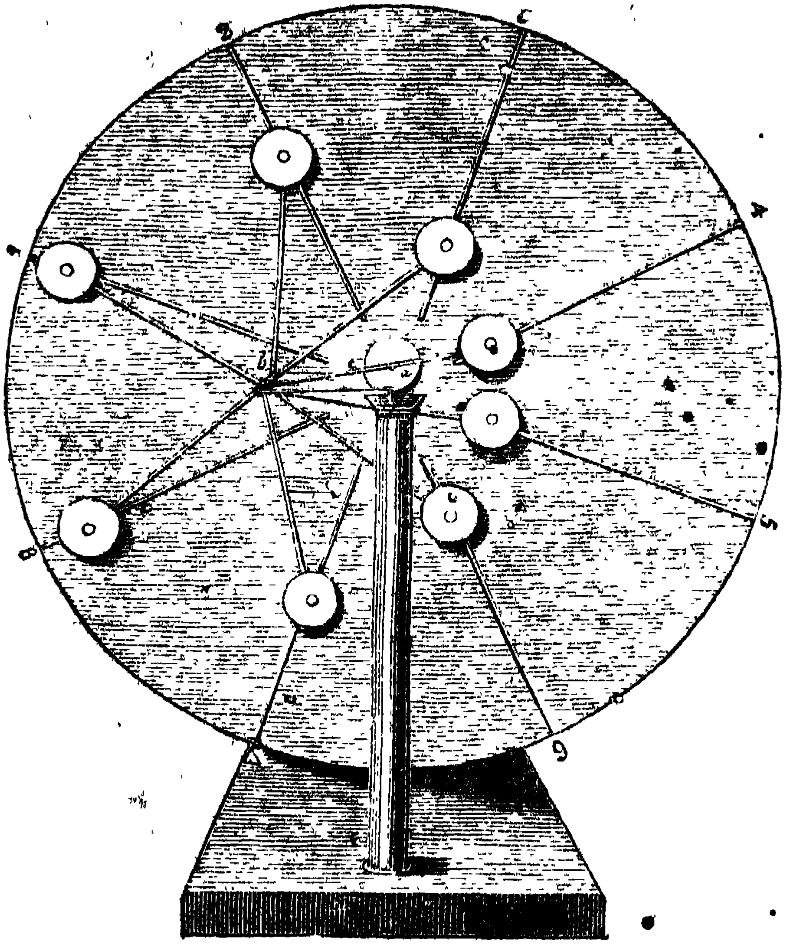
MARQUIS OF WORCESTER'S 56TH INVENTION.

Sir,—In reading the Marquis of Worcester's Century of Inventions, I observed, in the 56th Article, that a wheel was so contrived, with weights attached to it, that the descending weights would be perpetually farther from the centre than the ascending ones. The Marquis states, that no sooner these weights pass the diameter line on one side, but they hang a foot farther from the centre; and no sooner pass the diameter line on the opposite side, but they hang a foot nearer. He states, at the conclusion, "be pleased to judge of the consequence." Now we might very naturally suppose this to be a perpetual motion; but if I am right in the construction of the machine, it is very far from being one; for I find the wheel will travel much better without the weights.

The working model I have sent you, appears to me to be the same contrivance as the Marquis of Worcester's; for, no sooner the weights pass the diameter line on one side, but they hang two inches farther from the centre; and no sooner pass the diameter line on the opposite side, but they hang two inches nearer the centre.

My motive for sending the model to you is, that, being an indifferent draughtsman, I was fearful I should not be understood. I beg to observe, that I have used every means in my power, for the last twelve months, to find out if any thing like the model I have sent you has been made before, and I cannot hear of any thing of the kind.

I am yours, respectfully,
W. THOMAS.
7, *Price's-street, Blackfriars-road.*



[The model transmitted to us by Mr. Thomas is made of tin, and the wheel consists of two circular plates, about two inches apart, and connected together by wires soldered to their edges. It is supported by two pillars, upon which its axis rests; and in the engraving, the side of the wheel next the spectator is supposed to be removed, to shew its interior construction. The axis of the wheel, instead of passing directly through its centre at *a*, is bent at right angles on the inside of each of the circular plates, and, crossing between them at some distance from the centre, a new axis is formed at *b*. Round this axis, as a centre, eight weights are made to revolve by turning the wheel, and therefore successively approach and recede from the real centre in the course of their revolution. The weights, of which the ends are seen in the diagram, are in the form of cylinders, and are connected by means of wires with their centre at *b*. At the extremities of these cylindrical weights are pins, which move in notches cut through the circular plates, as at 1, 2, 3, &c. Mr. Thomas's model, though rudely constructed, is an ingenious attempt to embody the description given by the Marquis, but we certainly cannot admit that it is "the same contrivance."—Ed.]

COMBUSTION OF STEAM.

To the Editor of the Mechanics' Register.

Sir,—As our excellent and worthy President has invited the attention of your readers to the facts mentioned in his notice of Mr. Evans's Steam Furnace (Vol. II. page 258), I have ventured to offer you my crude ideas on the subject, and I shall preface my observations with one request, viz., that should they (in the words of your modest and ingenious correspondent, "A juvenile Philosopher,") "impress you with my ignorance or arrogance," you will, as you doubtless have many others of equal value, commit them to the flames. On considering the subject, the first question that suggests itself is, Does the Steam act *chemically* or *mechanically?* In either way it does not appear to me to be very difficult of explanation; should I be in error, I shall be very happy to be corrected by any of your scientific readers. First, then, supposing its action to be *chemical*—We know, that in the combustion of hydrogen, water is always produced by its union with the oxygen of the atmosphere; the fuel itself, therefore (hydrogen and carbon), would produce one portion of water. The steam (oxygen and hydrogen) in passing through the ignited carbon, is decomposed; its oxygen, by a superior affinity (as in its decomposition by iron), is seized by the carbon; the hydrogen becoming free, undergoes combustion, being supplied by the atmosphere with oxygen, and thus, if the combustion be complete, would produce the same quantity of water as was originally consumed, which, with that produced by the fuel itself, would account for the increase. But it may be said, there is no proof that the steam is actually *decomposed.* This I admit; but knowing that its decomposition is effected by iron at a certain temperature, I think it is fair to presume, that carbon, in the state of ignition, would effect it also; its strong affinity for oxygen being well proved by the powerful influence it exerts in the reduction of the metallic oxides.

In the next place, supposing the action of the steam to be merely *mechanical*, there is still less difficulty in explaining the facts, both as to the increased temperature and quantity of water. The steam passing through the fuel, acts as a bellows, by occasioning a stronger current of air, and not being decomposed, the whole is of course again condensed, with the portion produced by the combustion of the fuel. The case referred to by your correspondent "A juvenile Philosopher," is not at all analogous, and if he will allow me to refer him to the "Annales de Chimie" for December, he will find that his explanation of that phenomenon has been anticipated, and upon good grounds pronounced untenable. At a future time, with your permission, I will submit to your notice a few remarks on this subject; at present, I fear, I have already trespassed too much. Yours,

Amicus.

MOISTURE IN THE ATMOSPHERE.

To the Editor of the Mechanics' Register.

Sir,—I do not agree with your correspondent, (Vol. II. page 413.) as to the cause of the lower bowl receiving most rain. The same assertion was made in a periodical some time back, and I then suggested to the Meteorological Society, that the cause might probably be, "*the lower bowl being less exposed to the wind, and therefore receiving a greater number of drops;*" for as the force of the wind will be accelerated by the bowl or any other obstacle, more of the drops will be carried past the bowl, and this will not be compensated by more being brought to it, because the acceleration does not take place till they arrive over the bowl. I know very little of Meteorology, but should like to see, through your valuable pages, the opinions of others on the above subject.—I am, sir,

Your obedient servant,

S. E. Ash.

ENGLISH GRAMMAR.

To the Editor of the Mechanics' Register.

Sir,—Having no other opportunity of replying to the following letter but through the medium of some respectable publication, you will much oblige me by inserting it, with a few remarks thereon, in the columns of your valuable Register, especially as they contain a lesson, which I am sure will not be lost upon, at least, two classes of your readers, viz., printers and sign painters, and may meet the eye of the gentleman who so kindly sent me his advice per post, though not post paid. I have lately caused an entablature to be placed over my school-room inscribed with these words, "J. REYNOLDS'S ACADEMY," and the moment the work was finished, this communication made its appearance:—

"REYNOLDS' ACADEMY."

"Sir,—The entablature of the front of your academy ought to stand as above; the additional *s*, is against a rule of English Grammar known to every school-boy; the error has prevented my sending my son to you, which I was on the eve of doing, and may, perhaps, have a similar effect on others. By this intimation I prove myself, though a stranger, yet

"Your friend,

"Oct. 17, 1825. "*Birch.*"

Now, sir, I think, my boys would deserve the birch, (an instrument of torture which, by the bye, I never use,) if, after having been taught grammar for one month, they should make so gross a blunder as that which "Birch" has committed, in his attempted correction; and, lest he should think I am building my arguments on my own authority, I will give the opinions of grammarians of known repute in their support. It is a common error, among many, to omit the *s* after an apostrophe, merely because the word ends in *s*; a principle which, when brought into practice on all occasions, is as ungrammatical as it is ridiculous. I have before me an example of this kind, in an excellent little work, whose title runs thus:—"Arliss' Pocket Magazine;" the very pronunciation of which implies, that it is a magazine fitted for a peculiar kind of pocket, viz., an Arliss pocket; do you know, Mr. Editor, of a pocket of that kind? It is impossible to understand it as the name of the proprietor, printer, editor or publisher. This is *one*, among the many violations of a rule which "every school-boy knows," and of which I could produce a host;—but I proceed to show cause why the *s* was not left out after the apostrophe. In Murray's octavo Grammar, page 170, Observation 2d, is the following:—In poetry, the additional *s* is frequently omitted, but the apostrophe retained in the same manner as in substantives of the plural number ending in *s*. as, "*The wrath of Peleus' son.*" This seems not so allowable in prose, as the following *erroneous* examples will demonstrate: "*Moses' minister,*"—"*Phinehas' wife,*"—"*Festus came into Felix' room,*"—"*These answers were made to the witness' questions.*" But in cases which would give too much of the hissing sound, or increase the difficulty of pronunciation, the omission takes place even in prose: as, "For righteousness' sake,"—"For conscience' sake."

Lennie, whose Grammar has gone through nine editions, and possesses considerable merit, places this subject in a more ludicrous point of view, in his notes on the seventh rule of Syntax, page 86, which I have here transcribed, as bearing more forcibly upon the subject. "It has lately become common, when the nominative case singular ends in *s* or *ss*, to form the possessive by omitting the *s* after the apostrophe; as, "James' book,"—"Miss' shoes." This is improper. Put these phrases into questions, and then they will appear ridiculous. "Is this book James'?"—"Are these shoes Miss'?" Nor are they less ridiculous, without the interrogatory form; as, "This book is James'," &c. So, "Is this academy Reynolds'?" "This academy is Reynolds'," *alias* bricks and mortar, Roman cement, &c.

I cannot close my remarks, without paying my humble tribute to the merits of Mr. W. G. Lewis's English Grammar. I have quoted Murray and Lennie, as being at present the most popular; but I am bold to affirm, that Mr. Lewis's Grammar is the only book worthy of being called a Grammar of the English Language; and will, eventually, if men will but use their own judgment, become more popular than any other. In the 86th page, beginning at the eighth line, are these words; "It must be remarked, that *'s*, of the singular possessive noun, is not commonly added to nouns ending in *ss*, denoting a *quality*; thus we say, 'for *righteousness'* sake;' not 'for righteousness's sake.' But we say, 'the witness's evidence;' the word witness being the name of the person." Lastly, at the bottom of the 143d page, we read, "It is incorrect to say, 'William Cartwright Lewis his book.' it ought to be 'William Cartwright Lewis's book.'"

If the writer of the above letter, by the signature he has used, intended that the party in error merited the "birch," your readers will judge for themselves who has most deserved it.

Apologizing (as indeed I ought), for intruding myself so long on your notice, and wishing your Register may only become extinct, when it ceases to be, what it now really is, a vehicle for conveying useful knowledge, I beg to subscribe myself—Your well wisher,

J. Reynolds.

Chadwell-street,
St. John-street Road,
Oct. 25, 1825.

OUTLINES OF PHRENOLOGY.

To the Editor of the Mechanics' Register.

Sir,—Dr. Spurzheim having recently resumed his lectures on the interesting subject of Phrenology, I beg to transmit to you an abstract of his illustrations of this "comical science." He professes to be pleased that the prejudices which formerly prevailed against his favourite science have greatly subsided—a science which few have heard mentioned but in ridicule, though I have no doubt, ere long, it will be acknowledged to be a system "founded in nature," and having "truth for its basis."

Many people would begin by asking the utility of it. I would reply in the words of Dr. Allen, "what can be more important than the consideration of man?—of man as a being who is alone endowed with the high gifts of intellectual greatness?" Phrenology, then, is the study of the most important part of man—it is the knowledge of his consciousness, his passions, his feelings, and his intellectual part, and of all studies it is the most important. The lectures, of which I give an abstract, are those which describe the individual organs, of which there is no account in Dr. Allen's lectures inserted in your first volume, so that any one, by furnishing himself with a cast, may acquire a knowledge of them.

Yours, &c.,

Rye. Tyro.

I shall, in this paper, describe the organs of Amativeness, Philoprogenitiveness, Inhabitiveness, Adhesiveness, Combativeness, Destructiveness, Constructiveness, Acquisitiveness, and Secretiveness.

1. Amativeness.—This organ is situated between the ears. In children it is very little developed, and this part of the head will be found flat in them, but it increases in size as the age increases. The feelings to which this part gives rise are such as are usually ascribed to the influence of *cupido*.

2. Philoprogenitiveness.—Nature has given a peculiar feeling to take care of the offspring. Some say parents take care of their offspring from a sense of duty; but does this cause exist in animals? Certainly not. The females of some animals will die to protect their young; while the male cares nothing about them: nor is this feeling alike in all animals, as some will take but little care of their young; and if we consider our own species, it will be found, that the mother takes more care of the offspring than the father. Now, if we examine this organ, we shall find it more developed in females, and in those animals which take great care of their young, than in men, or those animals which take little: and, we shall always find that in nations, in sexes, and in individuals, the strength of this feeling is in an exact ratio to the degree of developement in this part.

3. Inhabitiveness.—It is found that some individuals are much attached to their home, their native place; and such people have this portion of the brain more developed than others. Some are miserable if they cannot return home; and others cannot conceive how any person can like to go from home. With respect to animals, it is found that some choose the plains, some very high mountains; some birds choose the trees, some the rocks or ground. We thus see there is a disposition which induces them to live in certain situations. The hen likes to live on dry land, the duck in water; and if we examine them, we shall find great difference in the organization.

4. Adhesiveness.—It is a power which has hitherto been considered as fundamental; it is that manifestation or power which brings together, so as to constitute society. A modification of this feeling gives rise to friendship.

5. Combativeness.—Some species of animals are more disposed to fight than others, and some individuals of the same species, than others. People of great courage are always broad in this part of the head: the same with horses; if they have great breadth between the ears, they will be found always to possess

greater personal courage than those which are narrow; so that it is quite certain that there is a distinct organization for this power.

6. **Destructiveness.**—It is found that the feeling or inclination to destroy animals is more active in those individuals who are broad just above and a little below the ear: this is observation—it is a fact, and that is what Phrenology is founded upon. If we examine the heads of murderers, we shall find the organization in this part very large. But this organ is not given to destroy other men, but to kill animals, which power is necessary; but we observe, unfortunately, that this feeling, notwithstanding the influence of education, and the cultivation of the higher faculties, does break out and overpower them. Herbivorous animals have the brain small above and behind the ear. Carnivorous animals, on the contrary, we shall find, have the greatest quantity situated just above the ear.

There are some persons who have a great aversion to kill; if their existence depended on their destroying animals they would die. We find, also, persons who are quite ready for destruction; they kill any thing that is required, in a minute, and have not the least aversion to do so. *If we speak of an organ of destructiveness, we speak merely of a particular power, but not of its application; not that a man shall commit murder, because the organ of destructiveness is full;* for we must remember, in man, there is a combination of higher powers happily blended with the lower propensities, and this combination exercises a mutual influence on each class.

Dr. Spurzheim describes Secretiveness after Destructiveness, but the organs of Constructiveness and Acquisitiveness, are generally taken before it; we will, therefore, describe

7. **Constructiveness.**—This organ is situated behind and above the outward angle of the eye. Among mankind we observe a disposition to build: children frequently shew a particular talent for the mechanical arts, and they invent machines. If we examine the head of such, we observe that it is large just behind the outward angle of the eye. From the many observations made, the situation of this organ may be considered certain. We observe in persons, who possess this organ very large, a power of construction; but whether that person will be an artizan, a painter, or an architect, is another thing: we must not confound the power with its application.

8. **Acquisitiveness.**—It is that power which gives the desire of acquiring or collecting. It is much developed in persons who have a propensity to steal; though it is not to be understood, that every one who has this part large, is a thief. It is not a peculiar power for stealing, but we observe thus much, that persons who are very active in that way, and who shew a great propensity to steal, have this part large, but we do not say that every one who has this part large shall be a thief. In individuals who have, in an honest manner, tried to acquire riches, we see this part much developed. It is a power which is absolutely necessary to existence, as it gives the propensity of wishing to get.

9. **Secretiveness.**—Among the different characters found in society, there is one distinguished by the name of *cunning*. If we look to the configuration of the head of such a character, we shall find it broad above the ear, above the organ of destructiveness.

These are the several powers called *Propensities*. In my next paper I shall describe other feelings, which certainly have claims to be considered more than mere propensities, and they are called *Sentiments*.

ADULTERATION OF SUGAR.

To the Editor of the Mechanics' Register.

Sir,—If the following observations are thought worth inserting, I shall be glad to see them in the pages of the Mechanics' Register.

The inconsistency of the statements recently made in the newspapers respecting the adulteration of sugar, is sufficiently apparent to persons acquainted with Chemistry; but to those who are not, a few remarks on the subject may be acceptable.

Good moist sugar, free from adulteration, mixed with one-sixth of its weight of salt, becomes very deliquescent and nauseous to the taste; indeed, the saccharine or sweet taste seems lost, and the mixture assumes a dark colour. The same sugar, mixed with one-sixteenth or one-twentieth of its weight of salt, becomes very damp, and the taste is so powerfully saline, that the sweetness is entirely lost or destroyed. This quantity (about 6 per cent.) I fully believe may be produced from the cane, if grown in the salt marshes, as stated. Grass grown in our own marshes, is very different from that which is grown on meadow land; and many chemical works contain accounts of various substances which plants are capable of absorbing, when applied to their roots.

Although a great outcry has been raised, no satisfactory test has been given to detect the salt (if any) in sugar. The most delicate test would be to dissolve a portion of the suspected sugar in a little warm water, and add to it a drop of a solution of *nitrate of silver*. A dense heavy precipitate will be immediately formed, if there is the smallest quantity of salt present.

I am, sir, &c.

Exmouth-street. LEFT HAND.

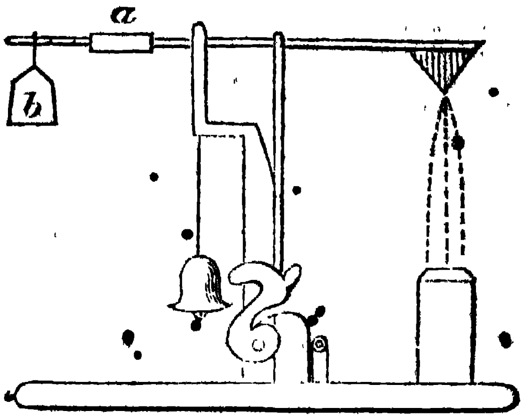
P. S.—Excuse the illegibility of the writing, as I have lost the use of my *right hand* these three years.

CHEAP ALARUM.

Sir,—Through the medium of your valuable Register. I wish publicity to be given to the following little drawing, which represents and improved alarum; its construction is so simple, as to need no explanation. I have examined the one in page 64 (Vol. I.) of your Register, and find that it cannot be made to go for any specific number of hours, as mentioned, which fault, you will perceive rectified in the enclosed, by moving the bit of iron, *a*, nearer or further from the weight *b*. The nearer *a* is to *b*, the quicker will the alarum strike.

I am, &c.

Z.



QUERIES.

No. 1.

YEAST.

Sir,—If, through the medium of your valuable Register, you, or any of your correspondents, can give information on the subject of Yeast, used by the bakers of the metropolis, I shall be much obliged. I wish to know if all the yeast used in London is supplied by the brewers of beer; and, if not, how it is procured? If there are such persons as makers of yeast, besides the brewers of beer, I wish to know from what ingredient it is made, and how made? Full information on these questions will very much oblige, your humble servant,

Camberwell. H. C.

No. 2.

Can any of your scientific readers inform me of the most probable cause of the *bloom* which is seen on grapes, plums, and some other fruit.

CALVIN.

Islington.

No. 3.

SIR,—If any of your ingenious contributors will explain the method of dying kid leather with shades of light blue and lilac, and black, he will oblige

Your's, &c.

G.

Borough.

No. 4.

Having a large garden, which is completely overrun with the Water-Dock, which almost appears to grow the faster for being removed, I wish to know how to prevent its growth; and should feel much obliged to any of your kind botanical correspondents, if they would do me the favour to send an answer, as early as possible, as I want to use the garden for domestic purposes. I should also be glad to know how to remove the spiders and earwigs, which abound in the same garden.

W. H. DEWHURST.

No. 5.

What is the best mode of polishing and darkening mahogany?

Repham.

No. 6.

What is the preparation necessary for etching on polished steel?

Repham.

ANSWERS TO QUERIES.

Query, No. 101, Vol. II. Page 382.

HEAT OF THE BOTTOM OF A TEA-KETTLE.

Your Correspondent, R. H., asks the reason why the bottom of a tea-kettle, on the outside, feels almost cold when immediately taken off the fire; but in a few seconds it is increased in heat?

It is a law of nature that the chemical affinity of bodies for caloric is one of the weakest of all the affinities at present understood, and that heated substances should part with a portion of their free, or uncombined caloric to the surrounding bodies which are at a lower temperature, till the whole become of an equal degree of heat. Apply this axiom to your correspondent's question, and it will solve the difficulty.

The tea-kettle being placed upon the fire, will attract a portion of free caloric from it; and if the kettle be empty and the fire brisk, the bottom will soon become red hot, because there is no substance surrounding it sufficiently contiguous to deprive it of the caloric it has acquired, and the neighbouring atmosphere is already in a state of highly increased temperature. But if the kettle be filled with water before placing on the fire, that effect will not take place; because the water, as it heats, gradually deprives the bottom of the kettle of the free caloric which it attracts from the fire, the water in the lower part of the vessel becoming hot first, rises upwards and makes room for fresh particles of the fluid, in their turn, to imbibe the caloric from the bottom of the kettle.

When, at last, the whole of the water boils, and no longer increase of heat being admitted, the remainder of the caloric, as it is formed, becomes converted into steam—continue the boiling as long as you will, no increase of heat will be produced; but, in time, the whole of the water will be dissipated [illegible]

And now comes the immediate explanation of your correspondent's query. When the kettle is removed from the fire, with the water still boiling in it, the heat which it had acquired is yet passing into the water, and from thence into steam, and as water has a very slight tendency to conduct caloric *downwards*, the bottom of the kettle feels hardly warm: but, when the water has ceased to boil for a few seconds, and a sufficient quantity of steam not being generated to carry off its caloric, it (according to the general law of nature which I have stated in the outset) parts with a great portion of it to the tea-kettle, as there is no other medium, excepting the atmosphere, by which it can free itself; and as the atmosphere in a nearly close vessel cannot attract heat in a very considerable degree, of course the kettle will then, to the touch, feel hot.

Luther.

Islington.

Query 104, Vol. II. Page 383.

COMBUSTION WITHOUT OXYGEN.

Until of late years, it has always been considered, that the presence of oxygen gas was absolutely necessary to combustion, not as being a combustible body in itself, but as being a *supporter of combustion*, and without the intervention of which, ignition could not be produced. Further experiments have more clearly elucidated this subject, and have discovered that, instead of *one*, there are at present *three simple substances* which support combustion, oxygen gas, iodine and chlorine gas, to which number, some chemists have added fluorine, or the base of fluoric acid; but it is not, by any means, generally admitted.

If a jar be filled with chlorine gas, and zinc or tin filings be introduced into it, they burn spontaneously, and will form a compound called a chloride.—Suspend a piece of solid phosphorus in the vapour of iodine, and it will burn freely, and give out heat without the interposition of any oxygen whatever, and the compound formed is called an iodide.

The nature of combustion, however, is not very well understood: it appears to be a double decomposition, but chemists differ in their accounts of the manner in which it is produced. From this short account it will appear, that as a general rule, oxygen gas is necessary for supporting combustion, but subject to the two exceptions which I have mentioned, and therefore it is quite clear, that combustion cannot take place in a vacuum.

Islington. LUTHER.

Vol. II. Page 304.

GASES GENERATED BY VEGETABLES.

Your Correspondent ELECTRIC, has not written very intelligibly in the first part of his communication on this subject; but he ultimately, and very clearly, puts these four questions, viz., 1st. "What gas do vegetables generate during germination and vegetation?" 2d. "Do vegetables in these, or in either state, tend to improve or to deteriorate the atmosphere?" 3d. "Do not vegetables improve the atmosphere, during the day, by absorbing carbonic acid gas, and giving oxygen; and deteriorate it at night, by absorbing oxygen, and giving out carbonic acid?" 4th. "Are there two classes of plants, one given oxygen, and another carbonic acid?" &c.

I shall answer these questions; and, by your leave, Mr. Editor, subjoin a few additional remarks.

To the first part of his 1st Query, I answer; Vegetables during their *germination*, absorb oxygen; indeed that process cannot be carried on without this gas: for in no gas, or mixture of gases, oxygen not being present, will seeds of any description germinate; and they give out at this time of germination a small portion of *carbonic acid gas.*

To the second part of the same Query I answer, in the words I formerly did, page 127 of Vol. II. viz.:—"Vegetables during their growth (or vegetation), *absorb* carbonic acid gas, which is formed in nature by combustion, respiration, fermentation, &c., and they *generate* oxygen gas."

His 2d Query he has in the note to his communication in a great measure *answered himself*, to which I beg to add, that vegetables during their germination absorbing, as already stated, oxygen, and forming carbonic acid gas, must to the extent of their action deteriorate the air; but vegetables in growing, absorbing carbonic acid gas, and supplying oxygen to the air, must improve it materially.

Now the size of the germinating bodies in nature being altogether insignificant compared with the size of the vegetating ones, the final results of germination and vegetation set off against each other, must be in favour of their vastly improving the state of the air."

For an answer to the 3d Query, I refer him to his own note; where he, in my opinion, satisfactorily *answers himself*, needing nothing therefore from me.

To his 4th Query I answer, there are not two such classes of plants as he names.

I know not of a single instance where a vegetating plant absorbs oxygen, and gives out carbonic acid gas by day; *or at least when exposed to the light of day;* but the very contrary.

ADDENDA.

Nature instructs us in no mode she has of ridding the universe of the vast quantities of carbonic acid gas formed in it, but by vegetation.

It is not necessary that vegetables should possess *oxygen*, to give it out to the atmosphere, an error I lately found a friend had fallen into in reading an excellent work on the subject.

No; the carbonic acid gas being decomposed, gives *carbon* to the plant, and *oxygen* to the air.

Leaves stripped from a tree (I believe Sir H. Davy states), will supply oxygen for a considerable time, in the same manner plants do.

Azote is found in some plants; but I know of none giving phosphorus *(phosphuretted hydrogen)*, as stated by "Electric."

F. C.

QUERY No. 87, Vol. II. Page 302.

EFFECTS OF VEGETATION ON THE ATMOSPHERE.

"If plants absorb carbonic acid gas and give out oxygen, which is essential to health and life, how is it that large cities, where but very few plants grow, are not very unhealthy."

It is found that gases lying in contact, whatever may be their relative specific gravity, attract each other, and combine intimately; not lying on the surface of each other, as oil or red wine would on water, &c.

Now carbonic acid gas being evolved in respiration, combustion, fermentation, &c., mixes intimately with the surrounding air, and would ultimately render it insalubrious. But this surrounding air, being, even at the calmest periods, in constant circulation, it is carried *from* cities to the country, and its place is supplied by air from the country, which has previously been driven there, and which has given to the surrounding vegetables its carbon.

And this circulation and decomposition will not merely act between the airs of cities and the neighbouring countries, but between the airs of one quarter of the globe and another, so that want of vegetables can never be felt in cities, since it is not at all necessary they should be found on the spot where the carbonic acid gas is generated. F. C.

QUERY, No. 69, Vol. II. Page 255.

CHEAP ELECTRICAL MACHINE.

A really useful electrical machine, within the compass of any man's pocket, may be made as follows:—Procure a wheel, turned very true, of hard dry wood of any convenient diameter, about three quarters of an inch thick, and mounted in all respects like a plate electrical machine; let the wheel be well coated very smoothly with *common* sealing wax, and provide a rubber of thick flannel or soft woollen cloth, perfectly dried every time the machine is used; this, if well made, will give out as large and equal a supply of electricity as the best plate. A good prime conductor may be made by procuring a piece of wood turned into the usual shape, coated entirely with tin foil, mounted on a dry wine bottle for a stand, with a piece of brass wire passed through the end and bent at the points, so as to come nearly in contact with the coated wheel; at the other end may be inserted another piece of brass wire with a knob, the machine will then be complete. A good substitute for the Leyden jar may be obtained by anointing the inside of a clean dry wine bottle to within two or three inches of the neck with strong gum water and putting in some finely granulated tin, shaking it well round and pouring out what does not adhere to the bottom and sides of the bottle; the outside may be coated with tin-foil in the usual way, put a cork into the bottle, and push a brass wire with a knob at the top through the cork till it reaches the bottom.

N. B. A powerful battery may be made in the same way.

F. CHAPMAN.

Spa Fields.

THE MANGOSTAN.

The Mangostan, is a fine fruit of Java, about the size of a small orange; it exudes a yellow gum from its succulent rind in wet weather, which is a variety of *Gamboge:* the Gamboge of commerce, is derived from a plant of the same Genus as the Mangostan; viz. the *Garcinia Cambogia.*

DEPTFORD MECHANICS' INSTITUTION.

THE necessary preliminary arrangements having been made, by a committee of gentlemen, for the purpose of establishing a MECHANICS' INSTITUTION at Deptford, a numerous meeting of Mechanics was held, on Tuesday evening, the 18th instant, at the Roman Eagle, in that populous town. The chair was taken, at eight o'clock, by Dr. OLINTHUS GREGORY, who has kindly consented to become the President of the Institution. Dr. BIRKBECK soon afterwards entered the room, and was received with every demonstration of cordial welcome. The Chairman, in an elegant speech, expatiated on the advantages of Mechanics' Institutions, and was followed by Dr. Birkbeck, who traced their progress, from their origin at Glasgow, to the present time; and concluded, by expressing his sincere hope, that the gates of knowledge would soon be as widely opened as the gates of mercy. Several donations were announced, and the proceedings of the meeting, which were conducted with the utmost unanimity, were such as to justify an expectation, that the Institution will be successfully established.

TO CORRESPONDENTS.

The suggestions of A Mechanic are well meant, but the obstacles to their adoption are more formidable than he appears to imagine.

We hope to remove the difficulty pointed out by A Member of the Mechanics' Institution in our next Number.

We are inclined to think that An Old Gentleman's experiment was frustrated by a flaw in his apparatus. If he can repeat it successfully, we shall have no objection to insert his communication.

The mystery alluded to by Try is too profound for us to elucidate.

Mr. H. Lewthwaite will be attended to in our next publication.

Several of our Correspondents, whose favours have been postponed from unavoidable circumstances, will find them in the present Number, and the communications of many others will be introduced as soon as possible.

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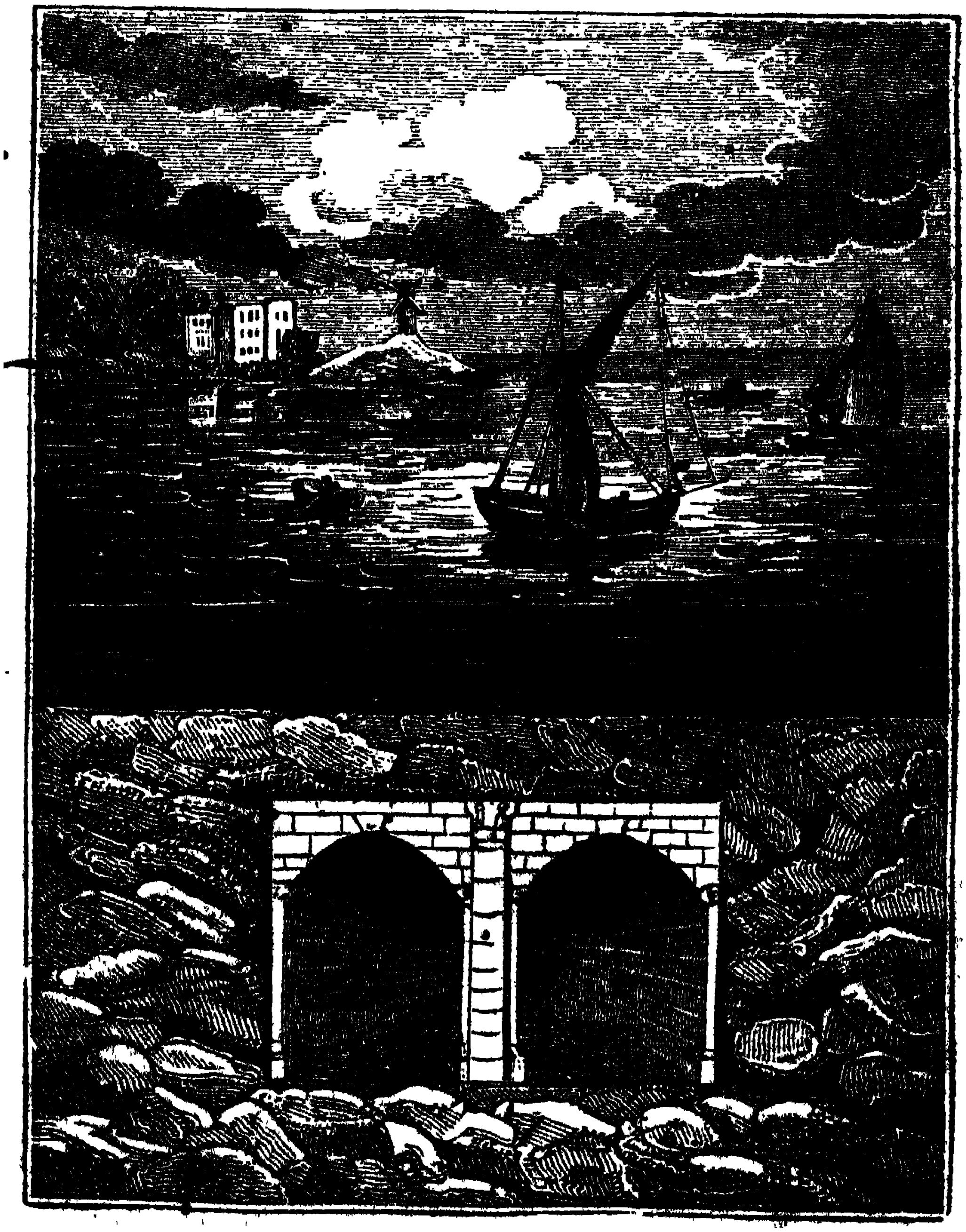
THE LONDON

MECHANICS' REGISTER.

——————"Where has Commerce such a mart,
" So rich, so thronged, so drained, and so supplied
" As London?---opulent, enlarged, and still
" Increasing LONDON?" --COWPER.

No. 58.] SATURDAY, NOVEMBER 5, 1825. [Price 3*d.*

A PLAN FOR A TUNNEL UNDER THE THAMES.



MR. DEWHURST'S PLAN FOR A TUNNEL UNDER THE THAMES.

To the Editor of the Mechanics' Register.

SIR,—Enclosed is a drawing of a plan of building a tunnel under the Thames, or any other river, which, according to my idea, is far preferable to the one now building at Rotherhithe. My plan is as follows:—

Let a certain and sufficient number of piles be driven into the bed of the river, which must be excavated to a sufficient depth to allow room for the intended tunnel. The water is to be pumped out by a steam-engine, and the tunnel built in a manner similar to that adopted for building a bridge. As it is completed, the earth that is dug out will assist in forming the bed of the river, and will also strengthen the arch. The tunnel ought to be constructed of stone, well clamped with iron-bars, for strength and durability. The approaches should be built upon an inclined plane, and not upon the plan of the Thames' tunnel, which, from the drawing of the plan I have seen, does not appear to me as if it would answer the intended purpose. The front, I would recommend to be built of stone, similar to the drawing, not only as being more ornamental, but possessing greater strength, as the arches are to be supported upon pillars of the Corinthian order, either of iron or stone. In fact, there should be pillars on each side of the tunnel, at proper distances throughout the whole length.

In carrying this plan into effect, the navigation of the river would not be more obstructed than it is at present, by the piles and machinery of the New London Bridge. The advantages of this plan are, that all danger of quicksands, &c., falling in is avoided, and that all the expensive machinery now in use would not be wanted. I have shewn the plan to several friends, among whom are three scientific gentlemen, who are now gone to Mexico, in the service of one of the new Mining Companies, and their approbation having induced me to transmit the drawing to you, if you think it worth insertion in your excellent work, you will much oblige, sir,

Your obedient servant,

HENRY WM. DEWHURST.

26, Prince's Road,
Kennington Cross.

LONDON MECHANICS' INSTITUTION.

MR. COOPER'S FIFTH LECTURE ON CHEMISTRY.

NITRO-MURIATIC ACID—ITS ACTION ON GOLD AND PLATINUM—COMPOUNDS OF AZOTE, WITH CHLORINE AND IODINE—CHLORIDE OF AZOTE—IODIDE OF AZOTE—THEIR DETONATING PROPERTIES—PRUSSINE, OR CYANOGEN—MANUFACTURE OF PRUSSIAN BLUE—ITS DECOMPOSITION BY RED OXIDE OF MERCURY, &c.

FRIDAY, OCTOBER 28TH.

PREVIOUS to the commencement of Mr. Cooper's lecture, this evening, the attention of the members, as they entered the Theatre, was attracted by the following curious remarks, which occupied a conspicuous station on the large diagram frame:—

"It has been demonstrated, that five volumes of *oxygen*, and two of *azote*, constitute *nitric acid*. It is equally demonstrable that, as we have now 1800 members, if each contribute only ONE VOLUME of *printed paper*, and ONE of *good will*, the product will constitute an invaluable addition of 1800 books to OUR LIBRARY of REFERENCE and CIRCULATION. A HINT!!!

This placard, we understand, originated in a suggestion made by a highly respectable Member of the Committee; and certainly, a more effectual method of conveying "*a hint*" to the Members, could not have been devised. We hope it will have the intended effect.

Mr. COOPER, accompanied by Dr. BIRKBECK and several of the Committee of Managers, entered the Theatre at the usual hour, and observed that, as he had, in his last lecture, illustrated the properties and manufacture of *nitric acid*, he should now treat of its combination with *muriatic acid*, the result of which is a compound of a peculiar kind, called *nitro-muriatic acid*. The peculiarity of this compound is its powerful action on certain metals, and it is employed for the purpose of dissolving *gold* and *platinum*, which cannot be effected by any of the simple acids. It is known, that both the nitric and muriatic acids are pure and colourless, and that neither of them, in a separate state, has any action on gold; but, if they are mixed in the proportions necessary to form *nitro-muriatic acid*, the compound will, in a short space of time, dissolve gold, which is introduced into it in a finely divided state. Mr. Cooper here produced a portion of *gold-leaf*, which he first immersed in nitric acid and muriatic acid, separately, when no effect whatever was produced on the metal. He then formed *nitro-muriatic acid* by mixing the two fluids, and, upon introducing the gold leaf into the new compound, an immediate chemical action ensued, and the metal, in a few moments, entirely disappeared. The reason of this is, that as soon as the two acids come in contact, a considerable evolution of *chlorine* ensues; the *oxygen* of the nitric acid abstracting the *hydrogen* from the muriatic acid, while its *chlorine* is set at liberty. The action of the acids upon each other, and upon the gold, is therefore solely attributable to the liberation of the *chlorine*.

If *nitro-muriatic acid* is kept for some time, it loses its property of forming a solution of gold or platinum, and it should therefore be used immediately. The acids of which it is composed are mixed in different proportions, according to the purposes for which it is intended. If we wish to operate rapidly upon gold, a much larger portion of *nitric acid* is necessary than is required for dissolving *platinum*. For producing a solution of gold, two parts of *nitric acid* to one of *muriatic*, are the proportions usually employed; and to dissolve platinum, about three parts of *muriatic acid* to one of *nitric*.

Having now finished the consideration of the various compounds of *azote* with *oxygen*, our attention will be next directed to the combinations of azote with the other simple supporters of combustion, viz., *chlorine* and *iodine*.

The first of these is a compound of *azote* and *chlorine*, called, from the name of its constituents, *chloride of azote*. This compound is produced by exposing any salt containing *ammonia* to the action of *chlorine gas*, but perhaps the *muriate of ammonia* is better adapted for this purpose than the other ammoniacal salts. Mr. Cooper here pointed out two glass vessels of chlorine, which were inverted in solutions of muriate of ammonia, by which means a portion of *chloride of azote* was formed at the bottom of the vessels. This compound possesses no very useful properties, but it is necessary to notice it with the rest of the combinations of azote with other substances. It must, however, be observed, that the chloride of azote is one of the most violent *detonating compounds* known in the science of chemistry, as it can scarcely be brought into contact with any of the combustible bodies without exploding. In consequence of the great violence, as well as the facility with which it detonates, extreme caution is necessary in operating with it, for it has been known to explode by merely coming in contact with a piece of deal.

The Lecturer here took a particle of this terrific compound from one of the vessels before him, and let it fall on a piece of deal. It did not detonate in this instance; but, upon repeating the experiment after moistening the piece of wood with *olive oil*, the compound instantly exploded with a vivid flash, though without much violence, owing to the minuteness of the drop which the Lecturer had shaken upon it. He observed, that in performing experiments with this compound, he was apt to feel rather *nervous*, for he had *once* experienced a severe injury from its explosive property; and, as the same compound, upon one occasion, nearly cost Sir Humphry Davy an eye,* the members would see the necessity of exercising the greatest caution in using this substance. Its action had been sufficiently shewn by the experiment just witnessed, and he was unwilling to run the risk of occasioning mischief by employing a larger quantity.

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* "I attempted," says Sir H. Davy, (Phil. Trans. 1813.) "to collect the products of the explosion of the new substance, by applying the heat of a spirit-lamp to a globule of it, confined in a curved glass tube over water: a little gas was at first extricated; but long before the water had attained the temperature of ebullition, a violent flash of light was perceived, with a sharp report; the tube and glass were broken into small fragments, and I received a severe wound in the transparent *cornea* of the eye, which has produced a considerable inflammation of the eye, and obliges me to make this communi[illegible] by an amanuensis. This experi[illegible]proves what extreme caution is necessary in operating on this substance, for the quantity I used was scarcely as large as *a grain of mustard-seed*.

If this substance is brought into contact with *phosphorus*, even under water, it explodes with such violence as to burst the vessel; but though it exhibits this explosive property, when in contact with almost all the combustible bodies, there are some few which do not produce this effect upon it. *Alcohol* is one of these bodies; and it may also be brought into contact with *quicksilver* without detonation. It was by inclosing a minute portion of *chloride of azote* in a tube with *quicksilver*, that Sir Humphry Davy succeeded in decomposing it, and determining its constituents. Under these circumstances, the decomposition proceeded quietly, and the substance was ascertained to consist of four volumes of chlorine, to one of azote, as represented in the following diagram:—

Chloride of Azote.

C	C	A
C	C	

Mr. Cooper had, on a former occasion, alluded to the strong affinity of *chlorine* for *quicksilver*, and it was therefore evident that, in Sir H. Davy's experiment, the *chlorine* passed over to the *quicksilver*, while the *azote* was set at liberty.

The next substance of which *azote* forms a part, is also a detonating compound, and results from the union of *azote* with *iodine*. It is therefore called *iodide of azote*, and is somewhat analagous to the fluid compound already mentioned; the iodide of azote is, however, a *solid* instead of a *fluid* substance. *Powdered iodine*, when exposed to *ammonia*, loses its black colour and becomes brown, in which state it forms a detonating compound, which, when once produced, can hardly be handled without exploding. This substance is one of those which possess no properties of any importance, but which it is necessary to mention, as links in the chain of chemical compounds.

The compound which next requires consideration is one of considerable importance, and its illustration will, therefore, be dwelt upo[illegible] some time. By some chemists it [illegible] called *cyanogen*, and by others *prussine*. *Cyanogen* means "a generator of blue," and the term is, therefore, not inaptly applied to this substance; but the Lecturer preferred the adoption of the more familiar term *prussine*, in speaking of the substance which forms the salts called *prussiates*.

It will be necessary, in the first instance, to enter upon the manufacture of the well-known pigment called *Prussian blue*, which owes its origin to the decomposition of animal substances. Dry blood, hoofs, horns, old leather, curriers' shavings, &c., are all employed by the manufacturers of Prussian blue, and are obtained at a moderate expense. The first process adopted by the manufacturer, in the formation of Prussian blue, is to expose the dry blood, or other animal matter, in conjunction with *carbonated alkali*, or *pearl-ash*, to the action of heat. When these substances are heated together, to somewhat beyond a red heat, approaching a state of fusion, an impure Prussian blue is formed by the combination of the animal matter with the pearl-ash, while its *carbonic acid* is set at liberty. Mr. Cooper here observed, that he would endeavour to make some Prussian blue, according to the process he had described. He therefore took some *horn*, which he put into a crucible, with a sufficient quantity of *pearl-ash*, or *carbonate of potash*, and placed the crucible in a furnace, previously prepared, in the recess alluded to in the last lecture. While the alkaline and animal substances were heating together in the furnace, Mr. Cooper proceeded with his description of the manufacture of *prussiate of potash*, or *Prussian blue*, a portion of which, in a purified state, was contained in a bottle on the lecture table.

Having obtained his *metal*, (the name given by the manufacturer to the impure prussiate of potash first produced,) he makes a solution of this substance in water, to remove the impurities with which it is contaminated. These impurities generally consist of *carbon* or *charcoal*, the whole of which is got rid of by solution in water, and the prussiate of potash is brought to the state in which it appears in the bottle before the audience. After having thus obtained a solution of prussiate of potash in water, his next process is to prepare a solution of iron, which is to be added to the former solution, in order to produce *Prussian blue*. To ensure the successful result of the operation, the solution of iron must be of a peculiar kind, as its effect is imperfect, if it is not sufficiently *oxidated*. Upon pouring this solution of iron into the solution of prussiate of potash, *Prussian blue* is immediately formed. Mr. Cooper excited a smile amongst his hearers by adding, that the next step taken by the manufacturer, was to make his Prussian blue according to the price he intended to sell it for, by the addition of substances which deteriorated its quality, and diminished its colouring properties.

The Lecturer here exemplified the formation of *Prussian blue*, by pouring a solution of iron into the solution of prussiate of potash which stood before him, but observed that the result, from its appearance, might be more appropriately called Prussian *green*, than Prussian *blue*. This arose from the solution of iron not being sufficiently oxidated, but the defect would be remedied by adding an acid to the mixture. This was accordingly done, and the fluid, in a few minutes, assumed the fine dark blue tint required.

After stating that the composition of Prussian blue is of rather a complicated nature, as it consists of *iron*, *cyanogen*, *hydrogen*, and *oxygen*, Mr. Cooper observed that, under some circumstances, it is necessary that Prussian blue should contain a sufficient quantity of *alumina*, for a base. To accomplish this, the manufacturer adds to his solution of iron a quantity of *alum*, which consists of *aluminous earth* and *sulphuric acid*. As there is always an excess of potash, the sulphuric acid unites with this excess, while the *alumina* and *Prussian blue* go down together. Prussian blue, therefore, always contains more or less of alumina, according to the price at which it is sold.

When Prussian blue has been manufactured by the methods already adverted to, other processes are necessary, in order to form *prussine* or *cyanogen*. The Prussian blue must, indeed, be almost decomposed into its elements, before we can arrive at the substance we are in search of. It must, in the first place, be finely pulverised, and then boiled in water with the *red oxide of mercury*. By this means the decomposition of the Prussian blue is effected, and, after boiling for a short time, the blue colouring matter is destroyed, and the *cyanogen* is transferred to the *mercury*, with which it enters into combination, and forms the salt called *prusside*, or *cyanide of mercury*. This salt is then placed in a retort, and exposed to a gentle heat, by which it becomes decomposed, and its *cyanogen* being given out, a considerable quantity of coaly matter is left in the retort. The Lecturer exhibited the former part of this process by pounding some Prussian blue in a mortar, and heating it over a lamp, with water and the red oxide of mercury. He regretted, however, that he was under the necessity of deferring, till the next lecture, the decomposition of the *prusside of mercury* he had obtained in this experiment, in consequence of not having received the necessary apparatus in due time, to ascertain its efficacy. [The piece of apparatus alluded to by the worthy Lecturer did not arrive from the maker till the lecture was half over, and, of course, there was no opportunity of subjecting it to the necessary trial, previous to the public exhibition of its effects.]

The contents of the crucible, which had been placed in the furnace, as above stated, being now sufficiently heated, Mr. Cooper took it out of the fire, and exhibited it, in a red-hot state, to the audience. An intense chemical action was evidently going on between the *animal matter* and the *carbonate of potash*, and *carbonic acid* was evolved in great abundance. After allowing the crucible to cool, for a short time, Mr. Cooper broke it, and brought a piece of the *metal* it contained to the lecture table. He then immersed the metal, or impure prussiate of potash, in water; and having passed the solution through a strainer, to purify it as much as possible, he added the oxidated solution of iron to it, when *Prussian blue* was immediately formed in the vessel. Mr. Cooper remarked, that the manufacturers never put the metal into water while it is hot, as part of its *acid* is, in that case, lost by decomposition. He had done it, in the present instance, to accelerate the process, but the experiment had been performed too hastily to be well performed, and the product was, therefore, not so perfect, as if more time had been occupied in the operation. There were many other circumstances connected with the subject, which, owing to the disappointment he had alluded to, he must defer till the next lecture, when he hoped to illustrate the whole of the compounds produced by the agency of *cyanogen*.

DR. BIRKBECK then addressed the audience, and stated that numerous letters had been received, both by the Committee and himself, from various Members, who had lost or mislaid their *Tickets*. Considerable attention had been paid to this circumstance, as it was the anxious wish of the Committee to afford the greatest accommodation to the Members, with the least danger to the interests of the Institution; but the frequent recurrence of such applications rendered it necessary to direct the attention of the Members strenuously to the 23d section of the Rules, which states that "*no Member will be admitted, either to the rooms of the Institution, or to any General or other Meeting of the Institution, unless he produce his card.*" It was not intended that the full operation of this rule should be at once rigidly enforced, but the Members must be sensible that their own interest required that it should, shortly, be strictly abided by, for it was absolutely necessary to guard against the admission of two persons by one ticket. "You are aware," continued the worthy President, "that when we set a particular value upon any thing, we take care to preserve it; and, as I am sure you value your Tickets of Admission, I am convinced you will be careful of them, when you know that, by losing them, you will deprive yourselves of the advantages of the Institution."

LECTURE FOR NEXT WEEK.

Friday, November 4th, Mr. Cooper's Seventh Lecture on Chemistry.

[In the description of the manufacture of *nitric acid*, given in our last Number, it was stated, by mistake, that Mr. Cooper was enabled to ascertain the completion of the process, "by applying his hand to the vessel containing the *salt-petre* and *oil of vitriol*." It should have been "by applying his hand to the *receiver*," which remains hot while the distillation proceeds, but becomes cold when it ceases. We are obliged to "Onesimus" for pointing out this error, although his correction was not conveyed in the most courteous terms.—Ed.]

PROPOSED MECHANICS' INSTITUTION IN THE BOROUGH OF SOUTHWARK.

To the Editor of the Mechanics' Register.

Sir,—From the large extent of the Borough of Southwark, and abounding as it does with so many thousands of intelligent mechanics, and others who would, if opportunity offered, gladly avail themselves of the great advantages to be acquired at Scientific Institutions, and from the number of residents who have personally lamented with me that no public spirited individual could be found to propose an establishment in the Borough similar to the "London Mechanics'," or the "City of London Literary and Scientific Institution," I have, at length determined, for the purpose of trying how far such an inclination may extend or be encouraged among the Borough mechanics and inhabitants, generally, to call upon all such as may be inclined to attend a meeting for the purpose (to be called only should a sufficient number of persons appear favourable to the idea) to leave or send their names to Mr. Harrison's, Surrey Coffee-house, 18, Union-Street, Borough, and if by letter, post paid.

27th October, 1825.

[We very willingly lend our assistance to the views of the writer of the preceding letter, by giving it publicity in the pages of the Mechanics' Register. We are happy to find that the example set by the Mechanics of Deptford and Rotherhithe is likely to be followed on the same side of the water, by the operative artisans of the extensive and populous districts comprehended in the Borough of Southwark, and shall feel much gratification in recording the success of this, as well as of every other attempt to facilitate the acquisition of knowledge by the working classes.—Ed.]

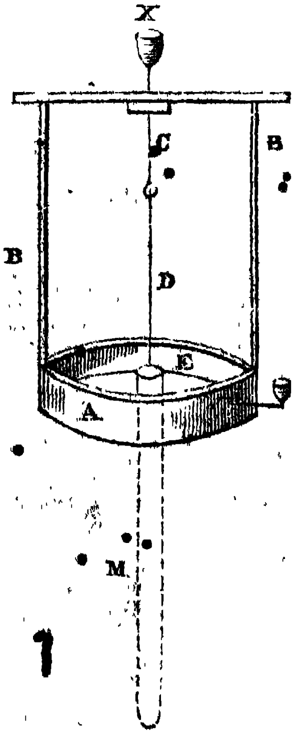
ELECTRO-MAGNETISM.

To the Editor of the Mechanics' Register.

Mr. Editor,—Stimulated by the various details of Electro-Magnetic Phenomena, given in your very interesting Register, I have been led to attempt a repetition of some of them; but my want of success, though after considerable care, and, I think, accuracy, in arranging my apparatus (and the persuasion it is your wish to make the path of knowledge as plain as practicable) induces me to trouble you with this communication, in hope that some of your more intelligent correspondents (with your permission) may set me right, and point out the reason of my failures.

I have a battery of near 200 four-inch plates at command, but in consequence of the hints contained in your report of Mr. Sturgeon's Lecture (vol. ii. p. 319.) that a small galvanic apparatus would suffice, I excited only 10 four-inch plates with a weak acid mixture. The apparatus, fig. 1. in the page above referred to, as used by Mr. S. for shewing the deflection of the magnetic needle, was adopted in my first experiment. The needle (8 inches long, ¼-inch broad, and ⅛th thick, and balanced on a brass point) had been touched by a 5-inch horse-shoe magnet, but had only a weak directive power. The cups were filled with mercury, and the connexions made by inserting the galvanic wires into them respectively—*but no deflection followed.* The experiment was repeated, substituting the action of the electrical machine instead of voltaic electricity, (as directed in Mr. Lewthwaite's 8th lecture, reported in vol. ii. p. 115.) the needle instantly deflected nearly 90°. but *the north or marked pole invariably towards the* WEST, *whether the spark was taken through the wire* OVER, *or* UNDER *the suspended needle*—an effect for which I am wholly at a loss to account.

I next attempted to produce the rotation of a freely suspended wire round a magnet; the arrangement was essentially, though not formally, similar to that described in Mr. Sturgeon's 1st lecture, (p. 318.) [it was as follows :—



A, a cup formed of card-board 3 inches diameter, and ½ an inch deep; BB, a light frame of beech-wood; C, a sliding brass wire, carrying the cup for mercury, with the hook at the lower end, on which was hung the slender brass wire D, near 3 inches long; E, a little socket in the middle of the cup *A*, for the reception of the end of the magnet M, which was brought up through the centre of a small table constructed purposely for the trial of electro-magnetic experiments.] The magnet used was 12 inches long, ¼ inch diameter; and though carefully touched with the before-mentioned horse-shoe magnet, capable of lifting only about ½ oz.

On forming the connexions with the respective sides of the voltaic battery through the cups, [X and Y] and filling the large cup [A] with mercury, so as just to immerse the point of the wire [D], *no rotation, nor the smallest apparent tendency to rotate was observable.*

With the same apparatus (removing the bar-magnet), the experiment for producing the oscillation of the wire was tried, and the before-mentioned horse-shoe magnet (lifting power 7½ oz.) placed horizontally half across the axis of the cup [A], still no effect followed on completing the voltaic circuit.

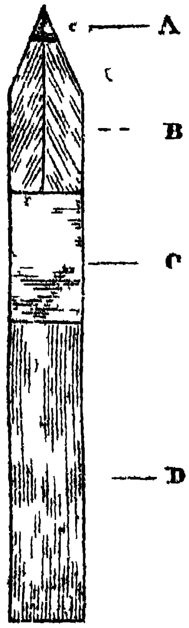
If (as I suspect) the failure arises from want of power in the magnets, I shall feel obliged by any competent correspondent stating, from *practical* experience, the *minimum* of lifting-power required, and the proportion it should bear to the oscillatory wire—as well as what should be the diameter of the wheel in the wheel and axle rotation experiment:—and also how best to prepare steel bars for the reception of magnetism; and, lastly, what is the simplest and most effectual way of communicating magnetism to them? I have tried Canton's method on 6 steel bars, 6 inches long, but whether they be not properly tempered, or from what other cause, I know not, their lifting-power is not above ½ an oz., whereas, it is stated, bars of that length may be made to lift 20 or even 28 oz.!

I fear I have already trespassed too long upon your valuable pages—but the insertion of these inquiries may be the means of producing some remarks, very acceptable to other Tyros, in this interesting branch of scientific investigation, and would much oblige, Mr. Editor, Your obedient servant,

THE RHODIUM PEN.

To the Editor of the Mechanics' Register.

Dear Sir,—The liberality you have always displayed in your valuable miscellaneous journal, by giving insertion to every new and useful invention, has induced me to send you a brief account of the *Rhodium Pen*, manufactured by Doughty, 10, Great Ormond-street. I consider this Pen to be a valuable instrument, not only to the man of science, but also to the man of business. The most material parts are, the *elastic gold spring*, which is so admirably made, that it can only be equalled by the quill, and the *Rhodium Nib*, which is attached to it, as shewn in the following sketch —



A, the rhodium nib; B, gold spring; C, silver block on which the spring B is fixed; D, the mounting for a sliding case or otherwise.

The *rhodium*, of which the nibs are made, possesses the following remarkable qualities first, it is sufficiently *hard* to scratch glass, consequently will not wear by the friction on paper. secondly, it is *insoluble* in all acids, therefore it cannot be acted on by the ink; and, thirdly, it is *infusible*—a pen possessing such valuable properties only requires to be known to be generally used. I am, Sir, Your's, faithfully,

John Lewthwaite.

Rotherhithe.

OBSERVATIONS ON STAGE COACHES, CARRIAGE-WHEELS, LATCHES, &c.

Sir,—I beg leave to submit to your mechanical readers a few subjects, to which, I think, the attention of the ingenious might be turned with advantage. Some things which I shall mention will, perhaps, be thought scarcely worth the room they will occupy in your pages, but, perhaps, they may set the mind at work, and lead the invention to strike out something useful. Rejoicing in the spread of knowledge,

I am, &c.

A Looker On.

I —ON THE LOADING OF STAGE COACHES.

I have often wondered that a contrivance is not made for placing the luggage of a coach much nearer the ground than is commonly done—why might not a luggage-box be fixed *beneath* the axle-tree instead of above it? The weight would then act as ballast in a ship, and greatly tend to prevent the carriage from overturning. I know that the coachmen will object, that the weight fixed so low would *drag heavier* But this, every well-informed mechanic knows is not true. The reason why it is commonly supposed, that a weight fixed low drags heavy is, because the lower the weight is placed, *the smaller the wheels* commonly are, and small wheels, for several reasons, we know, do produce a heavy draught, but, if the wheels continue the same, the draught, no doubt, must be the same

II.—ON PLACING THE LARGE WHEELS OF A CARRIAGE IN THE FRONT, AND THE SMALL ONES BEHIND.

If the large wheels of a four-wheeled coach could be placed before the small ones, I think several advantages would result The load might chiefly rest on the large wheels, which would be an advantage The large wheels, being best suited for overcoming resistances with least draught to the horses, would *smooth the track for the smaller ones*, &c But how, it will be said, could the carriage turn a corner, since the large wheels could not go under the coach?—I reply, let the large wheels be on a fixed axle-tree, as now, and let the small wheels behind be moved by a communication of wheel or crank-work with the pole—they would then act as a rudder does in turning a ship.

III.—ON CARRIAGES WITH TWO WHEELS ONLY.

These carriages are very unsafe, because, if the horse stumbles, the weight depends on his back. They are also, for the same reason, much more laborious for the horse, because, he not only has to drag a weight, but to support one also. Still, such carriages are much used; partly, because, as they admit of the wheels being very large, the draught is far less than that of a four-wheeled carriage bearing the same weight. Now, I would ask, could not some contrivance be made to do away with the dependence of the weight on the horse's back, so that, even if the horse falls, the carriage may not fall with it? Might not the carriage be *suspended from the axle-tree?*—If this could be done, what a security would it afford to two-wheeled carriages.

IV.—ON WINDING UP CLOCKS.

Plans have long been well known by which the opening of a room-door winds up a clock without any thought or attention from its owner. I am surprised that clocks are not regularly made on this plan, so that no forgetfulness may stop their going. Surely, it would well answer for some clock-makers to turn their attention to this subject; for I see no reason why I should have the trouble of winding up the clock in my parlour than of turning on and off the water in my kitchen. A floating ball does the one, and an opening door might do the other.

V.—ON SHUTTING DOORS BY WEIGHTS.

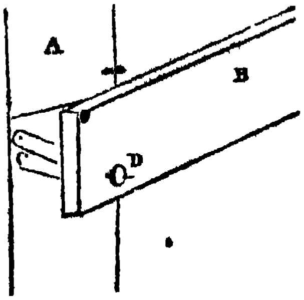
I have often been surprised at the silly way in which doors are shut by a weight and pulley. You hear a great noise every time the door is opened. Instead of fixing the cord to the outer edge of the door, it ought to be always placed a foot or so from the hinges; it would then open with no noise and little friction.

VI.—ON LATCHES OF DOORS.

Latches of doors are almost always out of order. I scarcely ever enter a house but I find the latch of the door in such a state, that it will not fasten without pushing it with considerable force, or drawing back the latch.—Latches are of two kinds—I do not know the names you give them, but one is the old-fashioned sort, which *lifts up*, the other has a spring and *draws back* by turning a handle.

With regard to the lift-up latches, if the door sinks a trifle, it brings the latch so low that, on shutting the door, it goes against the catch and cannot rise, unless lifted up; and even when that is not the case, the friction of the latch against the iron that fastens it to the door, and against which it slides, is very great.

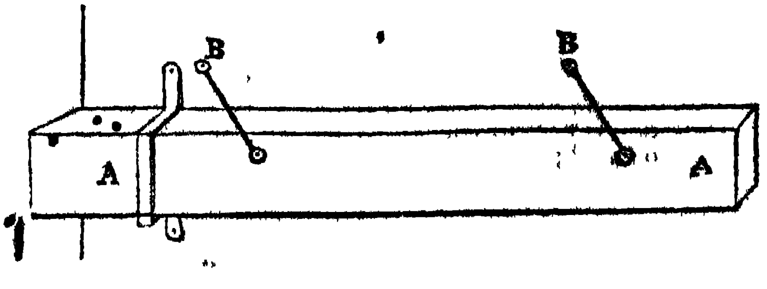
I would propose to take away the friction by a simple alteration which I have *tried*, and found to render *oiling* needless; but how shall I make my plan intelligible?



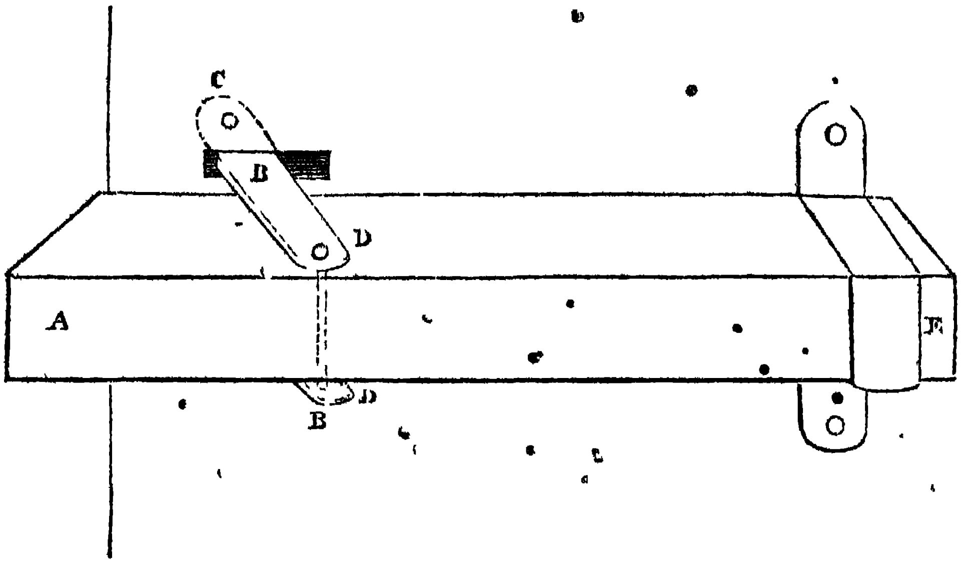
A is the edge of the door; B, a portion of the latch; C, a small flat piece of iron, one end of which goes through a hole in the latch, and is prevented from returning by a small pin at D; the other end is fastened to the edge of the door by a screw at C, yet so as to allow it to move on its centre. The edge of the door is cut away, so as to allow this small piece of iron to be fastened on without preventing the door from shutting.

Now, it is plain, that when the door is to be shut, and the latch comes in contact with the catch on the door-post, the latch has no other friction to overcome in rising than what arises from the small piece of iron, and it is surprising how easily the catch rises when so made.

But to remedy the continual derangement arising from the dropping of doors, I would propose to have latches made as I have seen wooden fastenings to gates, in some parts of Nottinghamshire. The plan is as follows:—



AA is a bolt similar to those which are commonly used in those latches which draw back. It hangs by two pieces of iron B B, and by its weight, from the oblique direction of the pieces by which it is suspended, it falls into a box-catch, when the door is shut, just as if it were forced by a spring. Fastenings thus contrived, are not deranged if the door sinks even half an inch. Still, however, these fastenings are liable to the same derangement as the common draw-back latches, viz., that of not readily moving back, because of the great friction against the iron which fastens it to the door, and against which it rubs as it slides back. Hence, our spring-latches scarcely ever shut easily, unless frequently oiled. To remedy this, I propose an appendage to the spring-bolt, and to the Nottinghamshire sliding-latch, similar in principle to that just proposed for falling-latches as follows. I draw it large to make it plain, and you will easily perceive that it is applicable to all sliding latches :—



A is the bolt; BB, two pieces of iron which are fastened at one end in the door, at C; the other ends are pinned to the bolt at DD. It is plain, that these pieces of iron almost reduce the friction to nothing. The other end of the bolt, at E, may slide as usual, because the friction is very little there.

COMBUSTION OF STEAM.

To the Editor of the Mechanics' Register.

Sir,—Having several times inspected Mr. Evans's method of applying steam for combustion, I beg to offer a few remarks, presuming, from the accounts I have read in your useful paper, that those who have noticed the subject have not witnessed the operation, which I am surprised at, as Mr. Evans affords every facility for inspection.

In the first place, the apparatus does not act as a *Blowing Machine*, nor is the steam taken from the passage communicating between the boiler and cylinder, but from a branch attached to the waste pipe; diverting only what may be required into a tube in front and across the top entrance of the ash pit. The tube is perforated with holes underneath, and the steam issues out at right angles with the current of air, by which it is merely carried in. That it is *decomposed* must be evident, as the flame will increase or decrease by opening or closing the stop-cock; there is, no doubt, a point or quantity which the coke will best act upon, for if the cock be suddenly opened, an inincreased flash will appear, which immediately deadens if the carbon be over saturated to carry on the process effectively; consequently it requires a little practice for the operator to avail himself of its full benefits.

Here I would beg to put a few questions to your intelligent correspondents, an answer to which will throw much light upon this subject, (as it requires only a proper investigation to be universally adopted, which would confer at least one great benefit upon this crowded metropolis;—the prevention of the vast clouds of dense smoke eternally issuing from our engines and manufactories):—First, can the steam do any possible good unless decomposed? Secondly, what would be the effects of blasting a fire with a stream of azote, or carbonic acid?—and, lastly, what are the uses and effects of a common air bellows?

Now, in my humble opinion, atmospheric air is not more a combustible than steam, nor can either be called supporters of combustion, but in consequence of, and in proportion to, the material afforded by decomposition. The affinity of the component parts of atmospheric air for each other being weaker than those of water, I suppose more heat must be evolved in the decomposition of water, and I attribute to this some advantage in the new application of steam, and not altogether to the inflammation of *hydrogen gas.* I cannot believe your intelligent correspondent "Amicus" serious, when he attempts to explain this process upon *mechanical* principles; a Blowing Machine, is, certainly, in itself, a *mechanical* contrivance, but the effects are *chemical;* on the contrary, in a steam engine, the cause or moving power, is *chemical*, and the effects *mechanical.*

With regard to a very intemperate letter upon this subject, signed "Wm. Gilman," and published some weeks ago, if any honour or merit be attached to this application of steam, I believe he has no claim to it, of which any one may be satisfied by a little enquiry, if his want of temper has not already convinced. However, Mr. Editor, these remarks are intended to induce, an enquiry, to prove the utility or the fallacy of an application, with which is connected most important results.

I remain, sir, yours very truly,

A Manufacturer.

Bankside, 1st *Nov.* 1825.

MOISTURE IN THE ATMOSPHERE.

To the Editor of the Mechanics' Register.

Sir,—From the insertion of my last letter, I presume I may again venture to trespass on your pages with an observation or two, on the meteorological fact, to which your correspondent "A juvenile Philosopher" has adverted, as explanatory of the effect produced by Mr. Evans's steam furnace.

Mr. S. E. Ash has, I observe in the last Number, offered another explanation, but, as I think, I shall presently prove to him, by no means a satisfactory one. I must, however, first beg leave to remind Mr. A. that in all matters of theoretical controversy, the first necessary step is, to endeavour to point out the fallacy of your opponent's argument. Mr. A. contents himself with saying, "I do not agree with your correspondent,"—possibly not; but the mere advancement of one theory in opposition to another, amounts to nothing, and would tend only to endless disputation. Of the two I think the explanation of "A juvenile Philosopher," by far the most probable, and for this reason—that the hygrometer is allowed to be by no means an instrument which can be depended upon in experiments which require a nice degree of accuracy, when the atmosphere is excessively charged with aqueous vapour. One simple circumstance will, however, convince Mr. Ash that his suggestion is founded upon a very erroneous idea, for the same fact occurs when the vessels are placed in a sheltered situation, so that the wind can have no possible effect on them. There needs, I think, no other proof of the fallacy of Mr. Ash's explanation. I shall now submit to your notice another to which I some time since invited attention in a late periodical; from some one of your numerous scientific friends I may, perhaps, be more successful. It is on the principle of attraction.

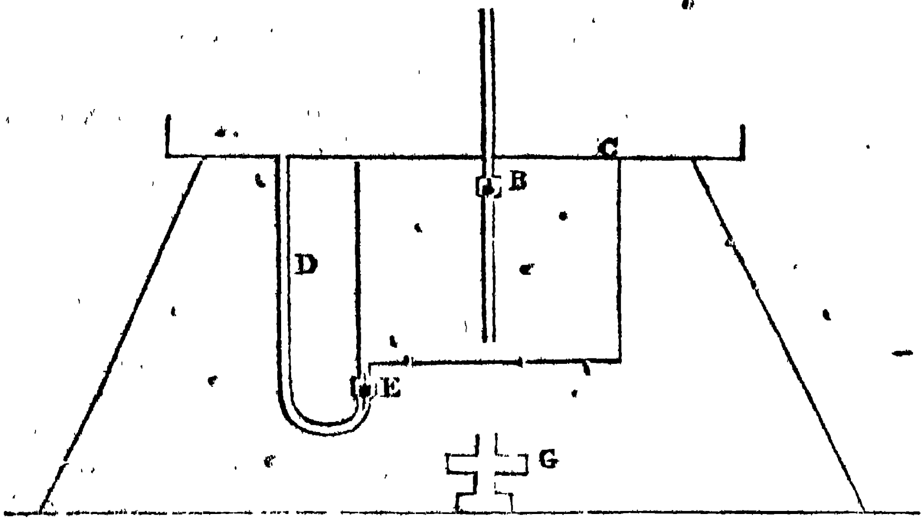
The aqueous particles, whilst suspended in the atmosphere, exist in the state of vapour, and are precipitated in consequence of the greater specific gravity acquired by their condensation to a state of liquidity. This change from the vaporous to the liquid form, is in fact nothing more than a closer approximation, or nearer contact of the particles, and by whatever cause occasioned, necessarily proves an attractive influence exerted by the particles themselves towards each other. If then it be true, as we are told by the most eminent philosophers; that this force, the attraction of aggregation, may be regarded as acting at sensible and insensible distances; it necessarily follows, that at a greater elevation the drops of water are at a greater distance from each other than at a less, and consequently a less quantity would fall on a given space. Yours, &c.

AMICUS.

MR. R. LEWTHWAITE'S STEAM FOUNTAIN.

To the Editor of the Mechanics' Register.

SIR,—Allow me, through the medium of your interesting pages, to return my thanks to your Correspondent, JOSEPH, page 367, of the Second Volume, for pointing out an error, which I had inadvertently committed, in describing my Steam Fountain, page 301. Your Correspondent observes, that the pressure of the steam, contained in the generator, will overcome the pressure of the atmosphere; and the steam will escape through the ball cock E, instead of forcing up a *jet d'eau*, as I had expected, in which observation he is perfectly right; but, Mr. Editor, I doubt not but, with a little alteration of its parts, the apparatus may be still made to act; which alteration will be best elucidated by the following sketch:—



It will be here seen that, instead of a ball cock, is substituted a tube D, which enters the generator at the bottom, as at E, at which place is a valve opening upwards; and in the jet B is another valve, opening also upwards; its action, when heat is applied, by the lamp G, will be as follows:—the steam which will be formed will press on the surface of the water, and open the valve at B, and force a *jet d'eau* out of the tube; at the same time, the valve at E will be shut by the pressure of water and its own weight, (being made of metal.) The jet will then continue to play, until the generator is nearly empty; the little water which will be left will be formed into steam, and part will escape through the valve in B; and part will be condensed by the water contained in C, and ultimately, a vacuum will be formed. As soon as this is the case, the valve E, at the bottom, will open and allow the water contained in C to enter the generator, while the valve at B will be shut by the pressure of the atmosphere, as soon as the water has entered the generator, the same effects will be produced by the application of heat. I hope your Readers will excuse the error which I had inadvertently committed, and should this not answer my expectations, I trust some more able Correspondent will improve upon it. I remain, Sir,

Your's, very respectfully,
ROBERT LEWTHWAITE.

Prince's-street, Rotherhithe.

N.B. If, after the fountain has stopped playing, the heat be removed, the condensation will be more rapid, and the generator will be sooner filled; after which, the heat can again be applied.

AN ACCOUNT OF THREE VOLCANOES IN THE MOON;

BY WILLIAM HERSCHEL, LL.D. F.R.S.

(Read before the Royal Society, April 26, 1787.)

AT a time when the newspapers are giving accounts of the marvellous discoveries of the German astronomers, who are said to have directed their optic glasses to the moon, in order

> " —— to descry new lands,
> Rivers, or mountains, on her spotty
> globe,"

till they have actually distinguished sundry edifices, cultivated gardens, &c. &c., the following paper, written nearly forty years ago, by the celebrated Dr. HERSCHEL, may afford some amusement to our readers. It was communicated to us by our correspondent, Mr. T. Taylor, who extracted it from a periodical work published in the year 1787.

" It will be necessary to say a few words by way of introduction to the account I have to give of some appearances upon the moon, which I perceived on the 19th and 20th of this month. The phenomena of nature, especially those that fall under the inspection of the astronomer are to be viewed not only with the usual attention to facts as they occur, but with the eye of reason and experience. In this we are however not allowed to depart from plain appearances, though their origin and signification should be indicated by the most characterising features. Thus when we see on the surface of the moon, a great number of elevations, from a mile to a mile and an half in height, we are strictly entitled to call them mountains; but when we attend to their particular shape, in which many of them resemble the craters of our volcanoes, and thence argue that they owe their origin to the same cause which has modelled many of these, we may be said to see by *analogy*, or with the eye of reason. Now in this latter case, though it may be convenient in speaking of phenomena, to use expressions that can only be justified by reasoning upon the facts themselves, it will certainly be the safest way not to neglect a full description of them, that it may appear to others how far we have been authorised to use the mental eye. This being premised I may safely proceed to give my observations.

"*April* 19, 1787, 10 h. 26 min. sidereal time.

"I perceive three volcanoes in different places of the dark part of the new moon. Two of them are either nearly extinct or otherwise in a state of going to break out, which perhaps may be decided next lunation. The third shews an actual eruption of fire or luminous matter. I measured the distance of the crater from the northern limit of the moon, and found it 3 m. 57 sec. Its light is much brighter than the nucleus of the comet which M. Mechain discovered at Paris on the 10th of this month.

"*April* 20, 1787, 10 h. 2 min. sidereal time.

" The volcano burns with greater violence than last night. I believe its diameter cannot be less than 3 sec. by comparing it with that of the *Georgian planet*. As Jupiter was near at hand, I turned the telescope to his third satellite; and estimated the diameter of the burning part of the volcano to be equal to at least twice that of the satellite. Hence we may compute that the shining or burning matter must be above three miles in diameter. It is of an irregular round figure, and very sharply defined on the edges, the other two volcanoes are much farther towards the centre of the moon, and resemble large pretty faint nebulæ that are gradually much brighter in the middle, but no well defined luminous spot can be discerned.

" WILLIAM HERSCHEL.

" *Slough, near Windsor, April* 24, 1787."

DECIMAL FRACTIONS, &c

To the Editor of the Mechanics' Register.

SIR,—I should feel greatly obliged if one of your numerous correspondents would inform me, through the medium of your valuable work, the meaning of the figures which declare the specific gravity of solids and fluids.

You will, perhaps, think my faculties very obtuse, in asking so simple a question; but, when I inform you, I never was at school more than twelve months in the whole course of my life (28 years), and that what *little* education I possess, I acquired by a persevering assiduity, and intense application, without any instruction but books, you will not be surprized at my wants, or deficiency of comprehension.

I have now commenced the study of chemistry, and having made myself tolerably well acquainted with the properties of most solids and fluids, I have arrived at their specific gravities:—now, in the specific gravity of gases, the figures are expressed sometimes thus, 29.546; I understand that 100 cubic inches weigh 29 grains and 546 *somethings*, but I do not know what. Now, sir, if some of your scientific correspondents would condescend to assist an humble enquirer, by explaining in the most plain and simple way the above queries, and also how I am to ascertain the strength or gravity of nitric and other acids, and where the instruments for the purpose are to be obtained, they will confer an obligation ever gratefully remembered by, sir,

Your constant reader,
A Member of the Mechanics' Institution.

[We would advise our correspondent, as he is a Member of the London Mechanics' Institution, to enrol himself immediately as a student in the arithmetical class, for the purpose of taking a few lessons in decimal fractions. He will find the acquisition both pleasant and easy; but to facilitate his chemical studies, in the mean time, we will endeavour to give him the information he requires, as intelligibly and concisely as possible. He will observe then, that the first figure on the right of the decimal point signifies *tenths*, the second *hundredths*, the third *thousandths*, &c. Thus, 29.5 is 29 and five-tenths, or one half; 29.54 is 29 and fifty-four one-hundredths, 29.546 is 29 and 546 one-thousandth parts, &c. In like manner, 29.05 signifies 29 and 5 one-hundredths; 29.005, 29 and 5 one-thousandths, &c. The same numbers, expressed in vulgar fractions, would stand respectively thus:—

$$29\tfrac{5}{10} \quad 29\tfrac{54}{100} \quad 29\tfrac{546}{1000} \quad 29\tfrac{5}{100} \quad 29\tfrac{5}{1000} \quad \&c.$$

He will perceive, therefore, that the value of a decimal fraction may always be ascertained by supposing *one*, or *unity*, to be divided into the number of parts expressed by prefixing the figure 1 to as many cyphers as there are figures on the right of the decimal point, and considering the decimal fraction itself as expressing the number of those parts. Our Correspondent will observe further, that 29.546 expresses the *actual weight in grains*, of 100 cubical inches of the gas referred to, and not its weight in relation to an equal volume of water, which is the estimate, when *specific gravity* is employed.

An *hydrometer*, of simple construction, will enable him to determine the specific gravity of nitric acid, or any other acid, and such instrument may be procured, by applying to Mr. Bate, of the Poultry, who, with so much ability, constructs the apparatus of Sikes.—Ed.]

QUERIES.

Sir,—Having derived considerable information by a constant perusal of your excellent little work, I shall feel obliged if you will assist me to increase that information by inserting the following queries:—

No. 7.

Are there any means of preparing prints so as to be enabled to colour them, the printing paper, in its original state, being unfit for such purpose?

No. 8.

Is it possible to restore the colour to silk, after having been stained by water, or other liquid being spilled upon it?

I am, sir,
Your obedient servant,
J. T. R.

No. 9.

Sir,—I wish to be informed of the cheapest and most efficient means of warming a house by steam. A description of the necessary apparatus, and an estimate of the expense, will oblige

Your constant reader,
I. N. H.

No. 10.

Sir,—I should feel greatly obliged to any of your correspondents, who can inform me of an expeditious and cheap method of staining or dyeing beech, pear-tree, maple, alder, &c., of a black, and also a red colour.

Greenwich. W. T. W.

No. 11.

I wish to know the true and optical reason why two lines which are parallel to each other, for instance, the top and bottom of a long row of windows, appear nearer to each other at the most distant than at the nearest extremity.

CALVIN.

Islington.

[The true optical reason of the effect alluded to by CALVIN is, that the apparent magnitude of any object depends upon the angle which it subtends from the point at which the rays of light proceeding from it meet at the *retina* of the eye. Now, it is evident that this angle must diminish in extent as the object recedes from the eye, and the object will therefore appear smaller, in proportion to the distance from which it is viewed. Applying this principle to the example given by Calvin, he will readily perceive the reason why two parallel lines, viewed from one end, appear to approach each other as they recede from the eye towards the opposite extremity; for, as the angle which they subtend gradually diminishes as their distance from the spectator increases, their apparent distance from each other must necessarily diminish in the same ratio.—ED.]

ANSWERS TO QUERIES.

QUERY, No. 1, Vol. II. Page 16.

COLD CEMENT.

To prevent waste of time and money, allow me to say, that if spirits of wine be placed "over a slow fire," and kept "close covered," so as "to prevent evaporation," as stated, page 222, Vol. II., the vessel containing it will inevitably burst, most likely setting the house on fire.

The garlic juice can only be desirable on account of its mucilage; and this will coagulate immediately it is added to the spirits of wine, and is, on that account, useless.

To form this cement most favourably, therefore, omit the garlic; and, having put the spirits of wine and isinglass together, and having suffered them to remain some hours together, not forgetting to shake them every now and then, you may place the vessel *in a warm place*, should the isinglass not be thoroughly dissolved. But it should be remembered, that very hot water will destroy the cementation made by this mixture.

F. C.

QUERY, No. 46, Vol. II. Page 173.

SMELLING-SALTS.

In answer to your correspondent, R. Yellow, respecting *salt of tartar* and *sal ammoniac*, I beg to state, that in this case, a double decomposition takes place; the potash, by superior affinity, takes the muriatic acid from the sal ammoniac, while the disengaged carbonic acid passes to the ammonia, and forms the carbonate of ammonia—the smelling salts of the apothecary. If quicklime is used instead of salt of tartar, the pungency will be greatly increased, but less manageable, the product being *gaseous*, whereas, in the former case, it is *solid*.

LEFT HAND.

QUERIES, NUMBERS 42 and 118, Vol. II. Pages 110 and 425.

BROWNING GUN BARRELS.

Half an ounce of nitric acid; sweet spirits of nitre, ½ an ounce; blue vitriol, 2 ounces; tincture of steel, 1 ounce, to be mixed together: the vitriol having been previously dissolved in a sufficient quantity of warm water to make, with the other ingredients, 1 quart of mixture.

Before browning the barrel, it is necessary it should be well cleaned from grease and other impurities, and that a plug of wood be put into the muzzle, and the touch-hole well stopped. The mixture is then to be applied, with a clean sponge or rag, taking care that every part of the barrel is well covered with the mixture, which must then be exposed to the air for 24 hours; after which exposure, the barrel must be well rubbed with a hard brush and rag, to remove the oxide from the surface. This operation must be performed a second or third time (if necessary), by which the barrel will be made of a perfectly brown colour. It must then be carefully brushed and wiped, and immersed in boiling water, into which a small quantity of alkaline matter has been put, in order that the action of the acid upon the barrel may be destroyed, and the impregnation of the water by the acid neutralized. The barrel, when taken from the water, must, after being perfectly dried, be rubbed smooth with a burnisher of hard wood, then heated to the temperature of boiling water. It will then be ready to receive a varnish of the following materials:—Spirits of wine, 1 quart; dragon's blood powder, 3 drachms; shell lac, bruised, 1 ounce. After the varnish is perfectly dry upon the barrel, it must be rubbed smooth with the burnisher to give it a glossy appearance. When the barrel is much rubbed from use, a little vitriolic acid may be applied to it; and then it must receive the treatment the barrels undergo after browning, care being taken to deaden the action of the acid, by means of boiling water. When brown barrels are in constant use, the brown may be continually kept perfect by the application of vinegar, which should remain upon the surface for a day, and then be washed well with boiling water.

If this operation be repeated once a month, a barrel which has been perfectly browned in the first instance, will continue in a proper state for a number of years, **A Subscriber.**

Query, No. 1, Vol. III. Page 13

YEAST

Sir,—In answer to your correspondent "H. C.", No. 57, page 13, I beg to observe, that yeast is an acid, as appears by its soon turning sour; and it consists of a great number of subtile and spirituous particles, wrapped up in such as are viscid: when, therefore, this is mixed with liquor, it occasions an intestine motion by the interfering of particles of different gravities, as the spirituous parts will be continually striving to get to the surface, and the viscid ones continually retarding such ascent, and preventing their escape. I do not think that any discovery has yet been made of a substitute for yeast that will answer the purpose of house-keepers. When yeast is very dear or very scarce, the following expedient may be adopted, to make a less quantity suffice:—suppose it is intended to make 14lbs. of floor into bread; first, peel and boil 1lb. of potatoes, pour the water from them, beat them up very fine, and mix them with about a quarter of a pound of flour, then add as much of the warm water in which they were boiled as will reduce the whole to the consistence of common yeast; add about one-third of the yeast you would otherwise use for the 14lbs. of flour, and mix it well with the potatoes, &c. Cover the vessel over in which you make it, and let it stand in a warm place, until it has risen like a regular sponge and begins to fall again; this will be in about two hours, and you may then proceed to make your bread as usual.

London Road. **Thos. Taylor.**

Query, No. 49, Vol. II. Page 142.

TRANSPARENT SOAP.

Take a glass phial and half fill it with shavings of Windsor or curd soap, fill the phial with the best spirits of wine, put it near the fire until the soap is dissolved, then pour it into a mould of any shape required. **S. Hollands.**

Query, No. 105, Vol. II. Page 382.

ODORIFEROUS PASTILES.

Benzoin, gum and frankincense, of each 2½ drachms; gum myrrh, gum styrax, cascarilla bark, in powder, and nitrate of potass, of each 1½ ounces;—mixed and formed into a mass with mucilage of gum arabic and oil of turpentine. Or the following:—

Camphor, flowers Benzoin, powdered charcoal, powdered cascarilla bark, powdered Turkey myrrh, powdered nitre, of each equal quantities; beat them up with syrup sufficient to form a mass, and divide into pastiles of a conical form; or may mix with rectified oil of turpentine.

S. Hollands.

Query, No. 80, Vol. II. Page 255.

FIRE AND WATER PROOF CEMENT.

To half a pint of vinegar, add the same quantity of milk; separate the curds, and mix the whey with the whites of five eggs; beat it well together, and sift into it a quantity of powdered quick lime to bring it to the consistency of thick paste. Broken vessels cemented with this paste never separate. **S. Hollands.**

Query, No. 61, Vol. II. Page 237.

CEMENT FOR BROKEN GLASS, &c.

Dissolve five or six pieces of mastic, as large as peas, in as much highly rectified alcohol as will render it liquid. In another vessel, dissolve also as much isinglass (previously soaked in water until quite soft) in as much French brandy or rum, as will make two ounces, or about five table spoonsfull by measure, of strong glue, and add two pieces of gum ammoniac about the size of a pea, which must be rubbed or ground until they are dissolved; then mix the whole with a very gentle heat; keep it in a phial well stopped. When it is to be used, set the bottle in hot water; and after having warmed the surfaces of the articles to be joined, apply the cement, keeping the parts in close contact for about twelve hours. The joinings made with this cement can scarcely be perceived; and so strong is the union, that the substances will sooner break elsewhere than at the joined part.

S. Hollands.

Answers to Correspondents in our next.

London Printed by R. G. Gunnell and Co. Crown Court, Fleet Street.

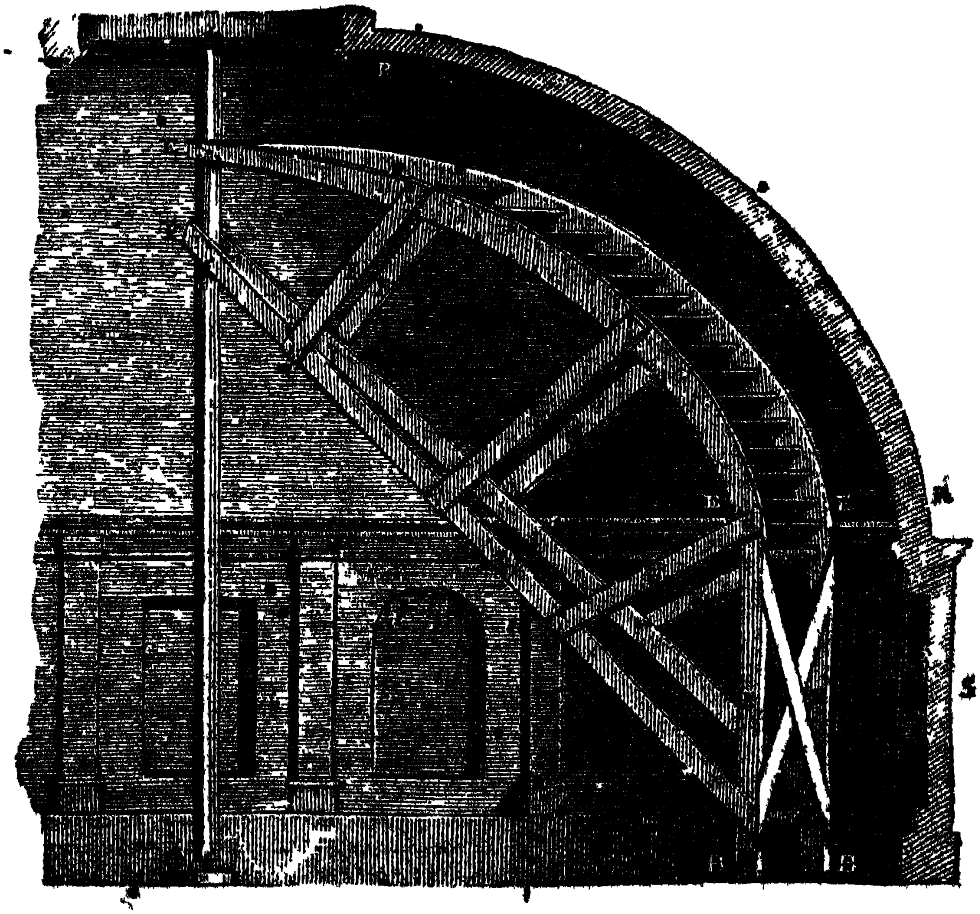
THE LONDON

MECHANICS' REGISTER.

> " Here measured laws, and philosophic ease,
> " Fix and improve the polished arts of peace;
> " There Industry and Gain their vigils keep,
> " Command the winds, and tame th' unwilling deep."
>
> GRAY

No. 59.] SATURDAY, NOVEMBER 12, 1825. [Price 3*d.*

MR. HUGHES'S SCAFFOLD FOR DOMES.



MR HUGHES'S SCAFFOLD FOR REPAIRING THE INTERIOR OF DOMES.

(From the MECHANICS GALLERY, Vol I)

THE completion of the First Volume of Mr PARTINGTON'S very excellent work, now publishing under the title of "THE MECHANICS GALLERY OF SCIENCE AND ART," affords us an opportunity of bearing testimony to its merits, and of strongly recommending it to the attention of the numerous class of individuals for whose instruction it is intended The author has been long known to the scientific world by his "Historical and Descriptive Account of the Steam Engine," his "Illustrations of the Marquis of Worcester's Century of Inventions," his improved edition of "Ferguson's Lectures on Mechanics, &c ," and from the clear and explicit manner in which he has elucidated the various subjects comprehended in the volume before us, we can entertain no doubt that the *Mechanics Gallery*, when completed, will considerably enhance the well earned reputation of the author

It is observed in the Prospectus, that "the prominent advantages of this work to artisans and mechanics will be, that every department of science and art will be complete in itself, and may be purchased separately Watch making, for instance, will exclusively occupy the first part, so of other arts, some of which will be completed in one part, others in two or three, according to the extent of their respective treatises By which means, every practical man, who may not require the whole work, may, at any time, furnish himself with such portions of it as best accord with his particular pursuit

"A complete and economical Artisan's Library has long been a desideratum, and the work now presented to the public will, it is presumed, recommend itself to general attention, as well from its novelty, as from the importance and extent of the subjects which it is proposed to embrace "

The plan sketched in the prospectus, has been strictly acted upon in the treatises contained in the First Volume, which afford ample evidence of the extensive and laborious researches of the author, in his illustrations of the different arts of which he has treated. He has not confined his remarks to the present state of the useful arts, but, as far as the obscurity in which the early history of some of them is involved would permit, he has traced them to their origin, and pointed out the progressive stages through which they have advanced, to the state of perfection in which modern ingenuity has placed them For instance, in the treatise on Clock and Watch making, which commences the work, the *gnomon* is first alluded to, as one of the earliest instruments employed in the measurement of time this is followed by the *clepsydra*, or *water clock*, and the subsequent application of wheel work to those horological machines of which water was the prime mover The first clock moved by weights is then referred to, and the various improvements in the construction of clocks, introduced in the course of succeeding ages, is minutely and accurately particularized Watch making is the next branch of the subject, and it is illustrated in the same comprehensive and perspicuous manner All the numerous parts which enter into the apparently complicated structure of a watch are carefully described, and their separate and combined operation distinctly elucidated This part of the treatise comprehends a description of the important horological improvements of Harrison, Graham, Berthoud, &c

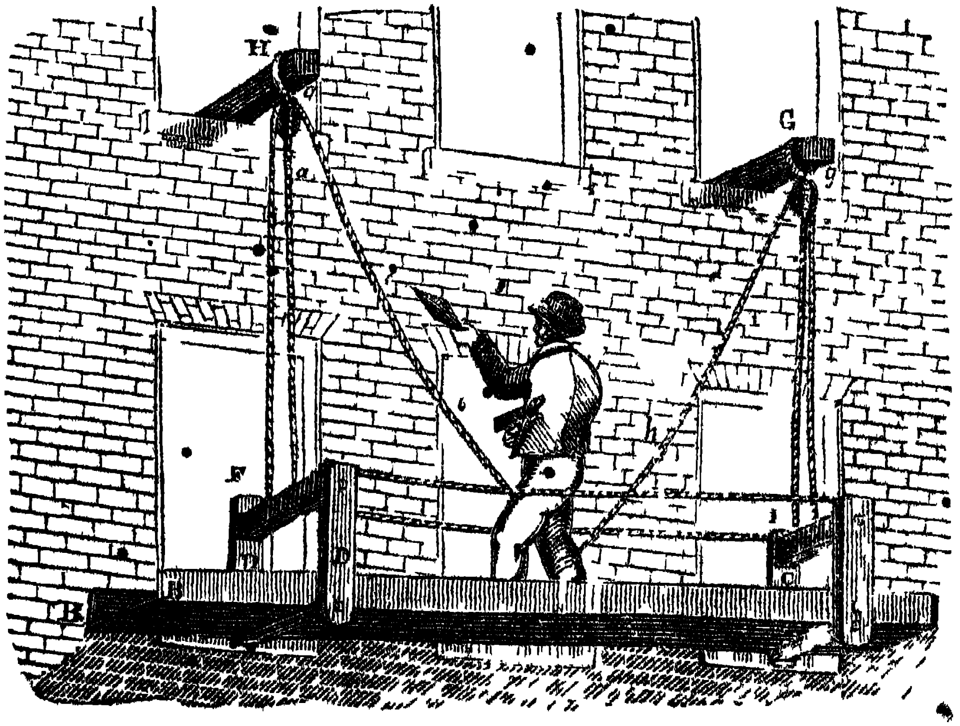
The preceding treatise is followed by an illustration of the art of *engraving*, in all its branches, which is succeeded by the *Coachmaker's and Wheelwright's* complete guide The next portion of the work is devoted to the art of *printing*, which is illustrated with a degree of ability commensurate with its importance, and the latter part of the volume comprises the *Builder's* guide, and contains a valuable treatise on *architecture*, with a full explanation of the arts of *bricklaying*, *masonry*, *carpentry*, *joinery*, *plumbing*, *painting*, and every other art connected with *building*.

From this part of the work we have selected the embellishment of the present Number, illustrative of Mr

Hughes's valuable contrivance of a scaffold for repairing the interior of *domes*, for which he received a reward from the Society of Arts, and which is described by Mr. PARTINGTON in the following terms:—

"This scaffold is made to move round on an upright pole, in the centre of the dome, and on two wheels running on the floor, so that it can be turned to all parts of the dome. The engraving represents an oblique elevation of the scaffold, as erected in the dome R R, of the building S. The chief support is a straight scaffold pole, A A, which turns on a pivot at the top, supported by a piece of wood fixed across the top of the dome in the centre, and is supported at the bottom on another pivot, resting in a step of wood fixed on the floor. To this pole a light braced frame is fixed, and traverses round on two rollers B B; these are situated at the bottom of the two upright legs, K K, which are nearly as high as the walls of the building. The tops of these support the ends of the two curved planks, C C, the upper ends of which are bolted on each side of the centre pole at D. Between these planks a number of boards or planks are placed horizontally, so as to form a scaffold, on which the workmen stand to work round the interior of the dome, at any height they find convenient. The width of these steps gradually diminishes from the space between the two uprights, B B, to a very small point at the pole near D. The whole is braced by two diagonal stays, I I, extending from the bottom of the uprights, B B, and secured to the upper part of the pole at E. The curved planks, C C, are also strengthened and supported by the short braces, F F, G G, and H H, which extend from the stays, I I, to the curves C C; these form a strong and secure scaffold, which may be easily moved round to any part of the internal dome at pleasure. To strengthen the frame sideways, diagonal braces are applied between the two uprights, K K."

In his remarks on the construction of *scaffolds*, the author also introduces the following ingenious contrivance, by which the pointing, and other necessary repairs of a house, may be performed at a comparatively small cost:—



"This simple and effective contrivance consists of nothing more than a couple of planks, A, to which two others, B B, are nailed, forming a sort of trough, or moveable scaffold, on which the workmen stand, which is suspended at any height at pleasure. C C and D D are two frames of wood, in which the trough or scaffold is fixed, in the top cross-pieces of these frames, two pullies E and F, are fitted, and round these the ropes by which the scaffold is suspended are passed, the ends, *a a*, of these ropes are made fast to two beams or scaffold poles, G and H, which project out of the upper windows, or they may be fixed over the parapet, or by any other means, as is thought proper, two single-pulley-blocks, *g g*, are also suspended from these poles, and the rope, after passing under the pullies, E and F passes over the pullies in these two blocks, and the ropes or falls, *h* and *i*, come down to the machine, and are made fast to any convenient part of it, therefore, by drawing these ropes, the workmen can, with the greatest ease, raise or depress the suspended scaffold to any place where it is wanted for work.'

The work is illustrated with numerous diagrams, neatly engraved on wood, in addition to a well executed copper-plate engraving which accompanies each part, and its utility is increased by the mode of publication, which enables the artisan to procure a distinct treatise on the art which he practices, without the necessity of purchasing those parts of the work in which he is not immediately interested We shall probably avail ourselves of future opportunities of submitting some further extracts to our readers, whose opinion we think will coincide with our own, that the *Mechanics' Gallery* will form a valuable addition to the stock of periodical literature.

LONDON MECHANICS' INSTITUTION.

MR COOPER'S SIXTH LECTURE ON CHEMISTRY.

FURTHER REMARKS ON THE MANUFACTURE OF PRUSSIAN BLUE—FORMATION OF THE PRUSSIDE, OR CYANIDE OF MERCURY—ITS DECOMPOSITION—PRODUCTION OF CYANOGEN, OR PRUSSINE—ITS COMPOSITION AND SPECIFIC GRAVITY—ITS COMBUSTIBLE PROPERTIES—ITS ABSORPTION BY WATER, &c —DETONATION OF CYANOGEN WITH OXYGEN—CYANIDE OF POTASSIUM—PRUSSIC ACID—SULPHO-PRUSSIC ACID, &c

FRIDAY, NOVEMBER 4TH

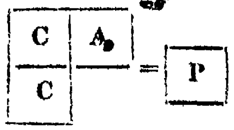
MR COOPER commenced the Lecture of the present evening by adverting to the experiments exhibited on the preceding Friday, relative to the manufacture of *Prussian blue*, and observed that, previous to continuing his remarks on the method of procuring *prussine*, or *cyanogen*, he would notice the results which had occurred, during the week, to the substances produced by the processes he had exemplified It would be recollected that, upon pouring a solution of *iron* into a solution of *prussiate of potash*, the precipitation was not perfect, but it had since perfectly subsided, and was now in the bottle before the audience It would also be remembered that an impure prussiate of potash had been formed, by the incineration of *horn* with *carbonated alkali*, or *pearl ash* Part of this product had since been properly purified, by washing, and the addition of the solution of iron had produced the dark blue colour, now observed in the vessel on the lecture table Mr Cooper here exhibited two vessels, each containing solutions of prussiate of potash, which had been further purified, by dissolving the crystals formed in the first solution. To each of these solutions he added an oxidized solution of iron, and the blue precipitate was immediately formed, but its colour was very different in the two vessels In the one case, the solution of iron was lightly oxidated, and the precipitate was of a *light blue* colour The highly oxidated solution of iron produced, on the contrary, a *dark blue* precipitate The former solution is the *black* oxide, and the latter the *red* oxide of iron, and the addition of an acid to the light blue precipitate, formed by the black oxide, is necessary to produce the deep blue colour required Hence, it is obvious that, in the manufacture of *Prussian blue*, the iron should be in the highest state of oxidation, to obtain the dense blue precipitate which is the object of the process The Lecturer here produced a piece of the black, coaly substance, formed during the last lecture, by heating the animal matter in a furnace, in conjunction with carbonate of potash, and which substance it was necessary to purify in the manner already described.

Another process, which was left unfinished at the close of the preceding lecture, was the decomposition of *Prussian blue* by the *red oxide of mercury*. The Prussian blue had been left heating with the red oxide and water, and by digesting the substances together, the oxide had taken the *prussine*, or *cyanogen* of the Prussian blue, to itself. After the products had been separated, and duly evaporated in a cold place, the result was the production of the crystals in the vessel on the lecture table, consisting of the *prusside*, or *cyanide of mercury*. To complete the process, and obtain *prussine* or *cyanogen*, in a pure state, it is necessary to place these crystals in a retort, and expose them to the action of heat, when a further decomposition will ensue, and a large quantity of gaseous matter, of a peculiar quality, will be given off. This gas, which is the *prussine* we are in search of, is rapidly absorbed by *water*, and it must therefore be collected over *mercury*. The disappointment which was experienced in the last lecture, arose from the *mercurial trough* not having arrived in time for the performance of this part of the process, and the Lecturer here expressed some surprise that, in a large metropolis like this, so much difficulty should be found in getting pieces of apparatus from the manufacturers. It often happened that Lecturers could not obtain the articles required for their experiments till the moment they wanted to use them, and they were thus exposed to inconveniences known only to themselves. He thought it necessary to mention this fact, that the Members might not imagine that blame was attributable to any of the Officers of the Institution, for the unavoidable postponement of the latter part of the process.

Mr. Cooper now put a portion of the crystallized *prusside of mercury* into a glass retort, which was placed over the flame of a spirit lamp, while the neck of the retort communicated with a cylindrical glass vessel, inverted in the trough of mercury. The first effect produced on the salt, by the application of heat, was its assuming a black appearance; and, as the decomposition proceeded, a large quantity of gas was evolved, and collected in the receiver, from which it displaced the mercury as it ascended, and became condensed by coming in contact with the cold quicksilver. A second receiver, of smaller dimensions, was also filled with the gas in a similar manner; and, when the whole of the *prusside of mercury* became decomposed, nothing was left in the retort but a quantity of black, coaly matter. It is necessary, to the successful production of *cyanogen*, that the salt should be perfectly dry, and free from the water of crystallization. The salt contains no water in itself, but a portion of that fluid is inclosed mechanically between the laminæ of its crystals during their formation.

While the decomposition of the *cyanide of mercury* was proceeding, Mr. Cooper adverted to the composition and specific gravity of *prussine gas*, which he explained by the following diagram:

Prussine, or Cyanogen.



$$12.708 \times 2 + 29.65 = 55.066 \left\{\begin{array}{l}\text{Weight of}\\ \text{100 cub. in.}\\ \text{Prussine.}\end{array}\right.$$

$$30.5 : 1{,}000 :: 55.066 : 1.805 \text{ Sp. gr.}$$

It will be seen by this diagram that *prussine* is composed of two volumes of *carbon* and one of *azote*; the three volumes being condensed into one by their union. It is therefore evident that 12.708 (weight of 100 cub. in. of carbon) multiplied by 2, and added to 29.65 (weight of the same quantity of azote) will give the weight of 100 cub. in. of *prussine*, which is 55.066 grains, as stated above. Its specific gravity, compared with that of atmospheric air, will also be found by the concluding statement; for as 30.5 (weight of atm. air) is to unity, so is 55.066 (weight of prussine) to 1.805, its specific gravity.

One of the properties of this gas is its being very *combustible*, and burning with a flame, the colour of which differs essentially from that of any other gas with which we are acquainted. Mr. Cooper here ignited a stream of *cyanogen* at the aperture of a small jet, when it instantly burst into a flame of a beautiful crimson colour, fringed with green or light blue. He had already observed, that this gas is rapidly absorbed by water, and he now exemplified this fact by agitating a portion of it in contact with a small quantity of water in a glass vessel, which he then opened in the mercurial trough, when the absorption was rendered evident by the ascent of the mercury in the vessel. Water, according to the experiments of M. Gay Lussac, is capable of absorbing $4\frac{1}{2}$ times its volume of prussine, but this proportion is small, in comparison with its absorption by some other fluids. *Alcohol* and *alkaline solutions*, for instance, absorb it in much greater abundance. This effect the Lecturer exemplified by agitating a small quantity of a *solution of potash* with the gas, nearly the whole of which was soon absorbed, as was shewn by opening the vessel under mercury, which immediately rose till it almost filled the tube, with the exception of the space occupied by the alkaline solution. The small portion of gas which remained unabsorbed in the upper part of the vessel, might be considered as indicating the mixture of other substances with the cyanogen, and the degree of this impurity might be ascertained by employing a graduated tube.

The action of *potash* upon *prussine* is of some importance, for if a large quantity of the gas be added to a small portion of the alkali, the prussine becomes partially decomposed. If, on the contrary, only a small quantity of the gas be added to the potash, the prussine, instead of undergoing decomposition, enters into combination with the alkali, and produces a yellow solution, somewhat similar to *prussiate of potash*. If, however, we add to this product a solution of iron, no Prussian blue will be formed without the further addition of an acid. Mr Cooper now introduced a portion of *muriatic acid* with the vessel containing the *solution of potash*, which had absorbed the *cyanogen*, and observed that the addition of this acid produced the immediate escape of another gas, viz. *carbonic acid*, the presence of which was indicated by the depression of the mercury in the vessel. If he now passed up a *solution of iron*, he had little doubt that *Prussian blue* would soon be formed. This was accordingly done, but the cyanogen not being yet in a proper state to produce the required result, the contents of the tube were transferred to another vessel, and set aside for a short time, when the effect adverted to by the Lecturer took place, and the blue precipitate was formed.

Mr Cooper here observed, that it would readily have suggested itself to the minds of the Members, that the constituents of *prussine*, and the proportions in which they are combined, might be ascertained by detonating it with *oxygen* in a close vessel. He had already stated, that *prussine* or *cyanogen* is formed of two volumes of *carbon* and one of *azote*, and he now inquired what would be the new compound produced by adding *oxygen* to this gas?

"*Carbonic acid*," answered one of the Members.

"Right," said Mr Cooper, "and what quantity of *oxygen* must be added to *prussine*, in order to insure the decomposition of the gas into its ultimate elements?"

"Two volumes," was the reply.

"Certainly," said the Lecturer, "the addition of two volumes of *oxygen* to the two volumes of *carbon* will form *carbonic acid*, while the single volume of *azote* is set at liberty."

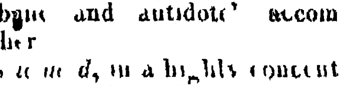
Mr Cooper now passed up into a vessel standing in the mercurial trough one volume of *cyanogen*, to which he added two volumes of *oxygen* from a bladder, and having thus produced a mixture capable of explosion, he transferred the mixed gases into a strong glass vessel, previously exhausted of air. A Leyden jar was then charged by the electrical machine, and the shock being passed through the gases, they exploded with a degree of violence which excited some alarm among the spectators. The detonation was accompanied by a vivid flash of an extraordinary colour, which left a singular impression on the eye for some minutes. The change that had taken place by a new arrangement of the parts of the mixed gases was now very evident: the *carbon* having entered into combination with the *oxygen*, to form *carbonic acid*, a considerable condensation of volume had taken place, but the cause of the violent explosion which accompanied the experiment, was the momentary expansion of the gases while separating from each other. To shew the formation of *carbonic acid*, Mr Cooper introduced a portion of *lime water* into the vessel, and, upon agitating it in contact with the gases, the lime-water assumed a milky appearance, but upon adding a little *muriatic acid*, its transparency was immediately restored. It was therefore evident, that *carbonic acid* had been formed by the union of *oxygen* with the *carbon* of the *cyanogen*, while its *azote* was liberated, and the constitution of this singular gas, was thus satisfactorily demonstrated.

Prussine is capable of entering into combination with a variety of combustible bodies, forming a number of peculiar compounds, according to the substance with which it is combined. *Potassium*, when heated in this gas, possesses the property of entering into combination with it, without occasioning its decomposition, and therefore forms a simple *cyanide of potassium* A retort, containing a portion of *potassium*, was now exhausted of air, and the vacuum was filled with *cyanogen* The Lecturer observed, that though a chemical action immediately commenced between the potassium and the gas, its operation was extremely slow, and was retarded by a coating or crust, which enveloped the metal, and protected it, in some measure, against the action of the *cyanogen*, so that several hours would elapse before their union was effected. By the application of heat, however, the potassium would soon become incandescent, and its fusion would facilitate its union with the *prussine* The Lecturer here applied the heat of a spirit lamp to the retort observing at the same time, that it happened, not unfrequently, that an explosion took place during the experiment. This, however, was not the case in the present instance, for the mutual action of the two substances proceeded quietly, the *potassium* being soon in a state of active ignition, while the *cyanogen* which filled the retort, imbibed a reddish hue from the heated *potassium* Mr Cooper here remarked, that this experiment was somewhat paradoxical, as it might be inferred that *prussine* was a *supporter of combustion*, but this is not the case All gaseous bodies contain *light* and *heat*, and perhaps *electricity* which are given out when they enter into combination with other bodies, and during the union of this gas with potassium, both light and heat are evolved The yellow compound formed in this experiment is a simple combination of *prussine* and *potassium*, and is therefore called *prusside of potassium*

This compound of *prussine* and *potassium* is analogous to the combinations of *chlorine* with metallic and other bodies It has been demonstrated, upon a former occasion, that when the *chlorides* are brought into contact with *water*, a double decomposition ensues, the *hydrogen* of the water combining with the *chlorine*, while its *oxygen* goes over to the metal, &c Exactly the same effect is produced by water on the *prusside of potassium*, as the *oxygen* of the water enters into combination with the *potassium*, while its *hydrogen* unites with the *cyanogen*, and forms *prussic acid*. This experiment is not very well adapted for public exhibition, as the decomposition is effected silently and imperceptibly

We find, therefore, that *prussine* or *cyanogen* is capable of entering into combination with *hydrogen*; but the direct combination of the two substances to form *prussic acid*, cannot be effected Recourse must therefore be had to the agency of other substances, and the *prusside of mercury* is generally employed for this purpose Mr. Cooper here introduced into a retort some *prusside of mercury*, to which he added *water* and *muriatic acid*, and, upon applying heat to the vessel, a quantity of *prussic acid* was soon distilled over. This substance is of recent discovery, though its combination with iron in the form of Prussian blue, has long been known Its smell is of a very peculiar nature, and resembles that of peach blossoms or bitter almonds, for which reason it is employed by perfumers to give a scent to pomatum, &c, and by distillers to communicate a flavour to certain liquors By distilling peach blossoms, bitter almonds or laurel leaves, a small quantity of essential oil comes over containing *prussic acid*, but this oil, and also water which holds the acid in solution are both direct and deadly poisons The Lecturer mentioned this circumstance as a caution to the Members not to indulge in liquors possessing this flavour By the distillation of bitter almonds, it is proved, that they owe their flavour to this substance, but, in the vegetable kingdom, wherever *prussic acid* is found, there is always something present to counteract its deadly influence, so that the 'bane and antidote' accompany each other

Prussic acid, in a highly concentrated state, not like that which has been produced in the last experiment, but procured by the agency of *dry muriatic acid*, without any admixture of water, so as to generate it in a pure state, and perfectly free from contamination, consists of one volume of *cyanogen* and one of *hydrogen*, which form two volumes by their union, as represented in the following diagram —



Mr Cooper here observed that though he did not profess to communicate pharmaceutical instruction, it might be necessary to state, that when this substance is applied to medical purposes, the substances employed in its production, are used in the following proportions —One pound of prusside of mercury, one pound of muriatic acid, and six pounds of water, are distilled at a low heat, down to six pounds, which product forms the prussic acid of standard medical strength.

Prussine enters into combination with *sulphur*, and forms with it *sulpho-prussic acid*. To produce this compound, it is necessary to employ the two constituents in a gaseous state, and to introduce them into an exhausted vessel, in the proportion of one volume and a half of *sulphuretted hydrogen* to one volume of *cyanogen*. Mr. Cooper accordingly passed the requisite quantities of the two gases into an exhausted receiver, and observed that, in making this experiment, if the gases are in a perfectly dry state, no action takes place between them; but if water be afterwards introduced into the vessel, a number of very minute crystals, of a yellow colour, will be seen shooting through the fluid. He had endeavoured to obtain the gases as dry as possible, to shew that, in this state, they will not act upon each other; and having now admitted a small portion of water to the mixed gases, he exhibited the vessel to the audience, but stated that the experiment was of a very delicate nature, and the formation of the compound in question, was hardly susceptible of demonstration in a Lecture room. Those Members who were near him might, however, perceive that the crystals to which he had adverted, were now darting through the water, and communicating a yellowish tint to it. Enough had been done to shew the manner in which *sulpho-prussic acid* is formed, and he need only add, that this substance is capable of combining with *iron*, but possesses no other remarkable properties.

Mr. Cooper concluded by stating that, as he had terminated his observations on *cyanogen*, and its compounds, he should, in his next lecture, take into consideration the nature and properties of *ammonia*.

LECTURE FOR NEXT WEEK.

Friday, November 11th, Mr. Cooper's Eighth Lecture on Chemistry.

HULL MECHANICS' INSTITUTION.

WE have been favoured, by DR. ALDERSON, the President of the Mechanics' Institution, recently established at Hull, with a copy of the able Address which he delivered to the Members, at the period of its formation. The persevering activity of this gentleman, in devoting his talents to the diffusion of knowledge, and his eligibility for the office to which he has been appointed, may be inferred from the following observations, with which his Address commences:—

"You have now accomplished your object,—the Mechanics' Institute is fully established; and I have to congratulate this Meeting on the successful termination of the labours of your Provisional Committee, as well as to express how much gratified I feel in having been thus called upon to address a few words to you on the occasion. 'My lot has been cast in happy times.' I had the honour, twenty five years ago, to lay the foundation of the present Public Library, and at its opening I addressed its members from the Chair, on the connexion which I could trace in history between Literature and Commerce. Soon afterwards, by an Essay on the advantage of Lectures, which I read at a Special General Meeting called for the occasion, I had the good fortune to prevail on a great majority of the subscribers to adopt a plan for public instruction, by Lectures, to be paid for out of the funds of that Institution. On that occasion, you may remember, that we procured the assistance of the present very justly celebrated Dr. BIRKBECK, whose talents we even then justly appreciated, to give a course of Lectures on Natural and Mechanical Philosophy. The no less justly esteemed Dr. MOYES also gave a course on the Philosophy of Natural History."

"I cannot but regret that this was discontinued, in consequence of an idea (a very mistaken one in my judgment) entertained by some few individuals, that it was spending their money on new schemes, contrary to the original intentions of the subscribers.

"We afterwards attempted to form a Commercial College; when I proposed to the three great Corporate Bodies, each to found a Professorship, for the purpose of teaching the rising generation of merchants and sailors the languages of the commercial world, and to establish a museum of specimens of all the articles of our trade. This scheme was not adopted here, but I had some gratification in seeing it approved of, and acted on, in other places.

"When the Botanic Subscription was completed, I had the good fortune to be selected to preside at the opening of the Garden, and I read a Lecture on the History of the science of Botany. Since that time, I have addressed as President, on its first establishment in this place, a Society for Literary and Philosophical purposes; and now that I am again called upon to address this still more practical and useful Institution,—like Simeon of old, I may 'depart in peace.'

"It is, permit me to say, at once gratifying to myself, and, what is of much more importance, highly useful to you, that I should thus recapitulate our advancement and progress in Literature and Science. When so much has been already done, ought we not to be the more excited to further and more energetic attempts?"

After a variety of interesting remarks on the important objects to be attained by associations, formed for the purpose of acquiring scientific information, the Doctor introduces the following observations, on the propriety of consulting the wishes of the young, in the choice of their future pursuits in life:—

"One great object of this Institution is to improve, by due exercise, those faculties which we feel a certain intuitive desire to employ in a particular direction. This I believe to be so true to nature, that I consider it an *imperative duty* to promote the cultivation of talents that are pointed out by the wishes of youth:—

'For since the claims
Of social life to different labours urge
The active powers of man, with wise intent
The hand of nature on peculiar minds
Imprints a different bias, and to each
Decrees its province in the common toil.'

"I will give you an instance of the fatal effects of thwarting this direction of nature, which fell under my own observation:—A sickly but very intelligent youth had always manifested a great and decided predilection for music, and if urged to exercise or exertion in any other direction, always showed great reluctance. When he was called on to learn the trade to which his father had successfully devoted his time and talents, he resisted, and proposed to follow music as a means of procuring a livelihood; but to this, his parents would not consent, and he was bound apprentice to an active employment. In the course of his apprenticeship, being often hurried, and sent here and there on business, to the extreme of fatigue,—his only solace was music; but, as a devotion to this was considered as an idle amusement, he was urged on to his stated duties until his constitution failed; and when I first saw him, he was evidently declining from an organic affection of the heart. He died, and was opened: we then discovered that his heart had been so imperfect from birth, that his inability to exert himself was a natural consequence of an organic malformation; that he must always have felt himself unable to move quickly without great distress; that his love of music might be said to have been instinctive, as he could freely indulge in that exercise without fatigue. In short, I am of opinion, that he died from an inattention to his intuitive feelings, a martyr to his profession; and I have no doubt that he might still have been alive, and an ornament in society as a music-master, had his faculties been exercised in their true direction.

"Whenever we find a youth devotedly fond of a particular pursuit, or decidedly averse to a destined employment, and at the same time are fully convinced that such predilection arises from no immoral or vicious habit, we ought to comply with his wishes—'it is the voice of nature:'

''Tis Heaven itself that points out his profession.'

And

'.... the poor Indian, whose untutored mind
Sees God in clouds, or hears him in the wind,'

acts more agreeably to the dictates of the Deity, than the wilful parent of polished life who resists such a wish.

Every one knows, that the best time to lay the foundation of learning, is in youth, and that dexterity also is best acquired whilst the hands are growing; but let not age be any impediment to a man's entering this Society from a fear that he is too old to learn. I have learnt more of the principles, the science of my profession, since I imposed upon myself the duty of lecturing on physiology to the pupils of the Infirmary, than I had previously acquired, by thirty-five years' practice; and I can assure those who are advanced in years, that they may yet feel the pleasure of learning, although, like me, they may have passed their grand climacteric."

The Doctor then discusses, at considerable length, the subject of Political Economy, and advances a variety of arguments, to prove that "*mechanical invention*," rather than "*simple labour*," properly constitutes the wealth of a nation. The assistance which simple labour derives from the use of machinery, is forcibly pointed out in the subjoined extract.

"The wonderful improvement that has been made in machinery, to shorten labour, within the last fifty years, would almost make one think that no further improvements are to be discovered. I can remember when spinning was performed by the distaff and spindle, much in the same manner as it was thousands of years before,—the women carried the lint, or tow, on a stick placed in their waist-belt, and having attached the thread drawn out by their left hand to a piece of hard wood, like a round foot-ruler, they twirled it against their thigh with their right hand, and thus gave a quick circular motion to the spindle, and so formed their thread. Then came the large wheel, with its band and spindle, this was set in rapid motion with one hand, whilst the spinner ran a considerable length with her yarn in the other, and then giving the wheel a contrary motion on her return, she wound up what she had spun upon her spindle, and thus repeating the operation, she continued to go backwards and forwards all the day long, with very little product for all her labour. Then came the wheel, in which the foot could be employed in producing motion, and then was made one of the greatest improvements in simple Mechanics,—the conversion of the perpendicular into the rotatory motion. But at what an immeasurable distance were all these contrivances put by the invention of spinning-jennies, within a very few years! In these we see how one man can do the work of fifty, by pure mechanic invention, and now that chemical power can be employed, we can see how one man may convert the product of the earth into a thousand times its value over simple labour. Here then we shew that it is not simple labour, but mechanic invention, that is the true and only source of wealth."

STOCKPORT
MECHANICS' INSTITUTION

Since we adverted to the measures in contemplation, for establishing a Mechanics Institution at Stockport, in Cheshire, (Vide Vol II Page 248,) a Public Meeting has been held, in the Theatre at that place, to adopt further steps for the accomplishment of this desirable object. A more numerous and respectable meeting has seldom been witnessed, and after the many difficulties, which it is generally understood the Committee of Arrangement have had to contend with, such a result must have been highly gratifying to them. THOMAS MARSLAND, ESQ., the Mayor, presided on the occasion, and briefly stated to the Meeting the purpose for which they were assembled; after which, RICHARD HEYWOOD, ESQ., proceeded to read an admirable Address, explanatory of the objects and plan of the Institution, which was received with much applause by the Meeting.

There is one part of this Address in which we do not coincide in opinion with its framers, we allude to the following explanation of the plan on which the Institution is to be conducted:—

"With regard to the terms on which Members shall be admitted the Committee of arrangement, after a careful examination of the various plans adopted at other Institutions, have resolved to propose that the Subscribers shall be divided into two classes—The first class—to consist of such individuals as make a donation to the institution of ten pounds or upwards at one time, who shall be honorary members for life, and of such as subscribe one pound per annum, payable quarterly or half yearly, in advance, who shall be honorary members so long as their subscriptions are continued; the Members of this class shall be entitled to all the advantages the Institution may be enabled to afford, and from their body the directors shall be annually chosen. The second class (to consist of such as subscribe 3s. per quarter) shall be entitled to the use of the library, and to attend all lectures, *but shall not be eligible into any office connected with the management of the Institution*. This arrangement, it is hoped will meet the approbation of the meeting, inasmuch as it includes most of the advantages of other systems, and avoids some particulars which may be deemed objectionable. The respectability of the management will be secured, and, at the same time, the benefits to be derived from the Institution will be brought within the reach of all classes of the community—two great objects which have, in many instances, been overlooked or disregarded."

Why the management of the Insti

tution is to be exclusively confided to the *honorary* life subscribers, or *honorary* quarterly or half-yearly Members, we are at a loss to discover. We are not acquainted with the local circumstances which may have led to this decision; but as far as our observation has extended, we have seen no reason to alter our opinion, that the individuals, for whose benefit Mechanics' Institutions are established, and by whose subscriptions they are supported, ought to possess a due share in their management.

We have, unfortunately, had occasion to notice an intolerant attack upon Mechanics' Institutions, by a Reverend Gentleman, named GREENFIELD, (Vide Vol. II. Page 254,) and we feel the most sincere pleasure in laying before our readers the gratifying contrast exhibited in the following remarks, which formed part of an eloquent speech delivered at the Stockport Meeting, by the Rev. N. K. PUGSLEY.

"I know not what the opinions of others may be, but, for my own part I consider the intellectual improvement of the world one of the legitimate objects of the Christian Ministry, and should feel myself utterly unworthy of the office I sustain, did I not approve of every Institution calculated to promote so beneficent a cause. I am not one of those who think that the interests of religion will suffer by the circulation of knowledge—I am for the universal education of the people. I would not extinguish a single ray of that light which is going forth among all classes of society, but, on the contrary, pray that, like the light of the morning, it may go forth dispersing brightness and beauty over our world, and shining more and more unto the perfect day. What, Sir, are the men who are appointed to illuminate and sanctify the world—who are set apart to train up society in the knowledge of the brightest revelations that ever came from Heaven—are they to be the abettors of ignorance, and all the vice and misery which ignorance entails? No, no, we are not such Vandals and Goths as this, after all,—and, I believe, if the annals of England's various Institutions were examined, it would there be found that no body of men have been more active in circulating knowledge, in elevating the mental tone of society, and in advancing the happiness of the world, than the liberal and enlightened Ministers of Christianity. I am well aware, Sir, that the direct object of this Institution, is to promote scientific knowledge, and the application of its discoveries to the arts and manufactures of our country. But, though this is its *direct* object, I cannot but hope that its *collateral* benefits will be of the highest importance to this town and neighbourhood. We live in a town, where, as it has been noticed in the Address, there is much low sensuality, brutish ignorance, and moral degradation. Is it too much to hope, that if we can bring these wretched outcasts of society to drink of the pure fountain of knowledge, the fountains of vice and intemperance will be forsaken? I think not, for I hold it as an unquestionable position, though there may be some exceptions, that in proportion as we raise the intellectual character of society, we also improve its moral feelings, and that not a few rise from the discoveries of nature up to the adoration of Nature's God."

ASHTON-UNDER-LYNE MECHANICS' INSTITUTION.

IN the course of the able and impressive Address, delivered by RICHARD HEYWOOD, Esq., on opening the Mechanics' Institution at Stockport, he alluded, in the following terms, to the establishment of a similar Institution at Ashton-under-Lyne:—

"Another objection necessary to be noticed here, is, that the mechanics will not avail themselves of the advantages we hold out to them. This has been urged by many individuals, but, arguing from the facts with which we are acquainted, relative to other similar establishments, we may safely assert that this objection is groundless. The Mechanics' Institution of Ashton-under-Lyne has not been established more than three months, and, on the authority of its President, who has kindly furnished the Committee with much useful information, we are enabled to state, that a material alteration has already taken place in the mechanics of that town. Upwards of two hundred members had been enrolled on the books of the Institution, and the zeal and attention they display in the attendance of lectures, and their frequent visits to the library, have astonished their warmest friends."

COMBUSTION OF STEAM, &C.

SIR,—Your intelligent and merciful Correspondent, AMICUS, states that the case referred to by me is not at all analogous; on this fact he and I coincide.

"The Steam Pipe," says Dr. Birkbeck, in your 45th Number, "was to be considered rather as a simple Eolipile, and, consequently, that the fire was urged by a very commodious *blowing machine*." "The steam," says your Correspondent, AMICUS, "passing through the fuel, acts as a *bellows*, by occasioning a stronger current of *air*." "The smith," says Dr. Birkbeck, "when he wishes to raise a powerful welding heat, generally throws water upon his fire." Here is a little inconsistency. The water used by the smith does not act as an Eolipile nor a bellows, yet it increases the heat of the fire. Seeing this, how can air, which is saturated with water, pass through a fire, with no more effect than dry air issuing from a "*blowing machine*," or a "*bellows*?"

Your Correspondent, Mr. ASH, states that he differs from me as to the cause of the *lower* bowl receiving *more* rain. Will your Correspondent permit me to ask him, whether he can conceive of a drop of rain passing through a moist atmosphere, and, consequently, coming in contact with innumerable particles of vapour, without coalescing with those particles, and inevitably increasing in bulk?

It seems, from your Correspondent's hypothesis, that the wind may contribute to the effect: on this I intend trying some experiments, the result of which will be at your service—for insertion or the flames.

I was ignorant that any part of my letter had been anticipated, as stated by your Correspondents, and I beg to apologize for my ignorance.

A JUVENILE PHILOSOPHER.

3d November, 1825.

HISTORICAL AND ZOOLOGICAL FICTIONS.

THE spirit of the Middle Ages, which possessed but little accurate knowledge, and therefore required the more food for a licentious imagination, was as much inclined to invent extravagant fictions, as to borrow them from others. The Monks, who almost alone possessed the important secret of the art of writing, forged, in their convents, monstrous legends and lying chronicles, in which weak princes, who had suffered themselves to be governed by the clergy, were exalted into saints; and those of the greatest abilities, if they had opposed the cabals of the cloister, were stigmatized as the weakest and most wicked of sovereigns. As their interest was supported by credulity, they encouraged the invention and propagation of wonderful fictions, which were the more readily received, as the minds of men were unaccustomed to examine or require proof. GERALDUS CAMBRENSIS, under HENRY II., wrote an account of Ireland, then newly conquered by the English, in which he asserted, that there were in that country *fishes with golden teeth, and monsters that were half men and half beasts; that ducks grew upon trees*, &c. &c., and these extravagant lies were received with so much approbation, that he read his topography of Ireland publicly at Oxford three successive days; the first day to the poor of the town; the second to the doctors of the different faculties, and the third day to the rest of the students, the town's-people, and the garrison

This love of the marvellous had filled the minds of persons of all ranks with such a number of prejudices, extravagant fictions, and superstitious fancies, that, after a lapse of several centuries, they are by no means all eradicated. As the light of knowledge increased, these fables were exploded; but the learned now went frequently too far, rejecting them all indiscriminately, as it was found too fatiguing to examine the confused mass, and distinguish truth from falsehood.

After the revival of science, such monstrous fictions were no longer obtruded on the world; but still the most unwarrantable and wanton liberties were taken with the truth. Of this I shall only give two examples. ÆLIAN relates that crabs may be taken by music, and the same has been repeated by many of the more modern writers on Natural History. When a certain wind instrument is played on, it is said, the crabs will come out of their holes; nay, even out of the water, and crawl (backwards, it must be understood) to the person who is playing. Not contented with this fable, a writer, in the year 1720, has given the musical notes, which such a new Orpheus must play to the crabs. Again, PORCACCHI says, in his description of the island of Sardinia, "that the *mouflon* (a kind of wild sheep) is found *no where but in the island of Sardinia;*" and, after some further particulars of their natural history, adds, "sometimes, *from four to five thousand moufflons are taken at once;* so numerous are they in the island, and so active are the inhabitants of the island in hunting them. Hence, according to some, the unhealthiness of the island; for, as the carcasses of these are left to putrify on the ground, they taint the air, which noxious winds contribute to render still more unwholesome."

PORCACCHI does not warrant the truth of this account; at least, he diminishes the certainty of it by an "it is said." Nor could he well do otherwise, if he recollected what he had just before said, viz., "that the moufflons inhabit the highest mountains, and run very swiftly;" so that it appears extremely improbable that they should be taken *by thousands*. But how many thousands of them must be taken, for their flesh, which he had before toid us is very wholesome, and well-tasted, not to be consumed as food? and what numbers of their carcasses must be left to corrupt, to infect the air of an island, containing 440 square miles? All this sufficiently shews that PORCACCHI was one of those observers, who would rather repeat what they have been told, however improbable, than take the trouble to search into the truth of it. Had he made such enquiry, he would certainly have found a better reason for the unhealthiness of the air of Sardinia, in the situation and nature of the soil of that island, than in the number of dead moufflons. The manifest improbability of the tale, did not, however, restrain DAPPER from translating the whole of it, word for word, from the Italian into Dutch, and applying to Cyprus what was falsely said of Sardinia. By what name shall we call such a fiction, in a work purporting to be an authentic history? Especially, as the Italian writer had said expressly, though untruly, a little before, that moufflons are found in no part of Europe, except Sardinia, and there certainly are none in Cyprus; nor is the air of that island said to be unwholesome,—yet has BUFFON been misled by DAPPER, to suppose the moufflon a native of Cyprus; and who can say how many writers of Natural History have followed BUFFON in this error?

J. D.

Malton Academy, Yorkshire.

ANSWERS TO QUERIES.

QUERY, No. 42, Vol. II. Page 127.

SPONTANEOUS VEGETATION.

In answer to the enquiry of "A young Farmer," on the spontaneous production of plants, I beg to observe that the generation of plants is, in a great measure, (if not entirely) owing to seeds, or principles which have lain latent, and hid in the strata of the earth ever since the formation of the world. That every earth is endued with a faculty of producing plants peculiar to itself, and that it had a seminal power communicated at the first creation of things, is, I think very obvious; because, if earth be dug out of the deepest pit or well, and carried up to the top of the highest mountain, it will produce plants proper to the country where they grow; and JOHAN. BAPTIST. PROTA., Lib. II. Cap. I, an author of good repute, writes, that when he had gotten earth out of the deepest cellars of certain houses of his neighbourhood, that there might be no suspicion of adventitious seed coming to it, and had set it in the open air on the top of his house, lest the winds should bring some into it from some distant region, not many days after, out of the several sorts of earth, in so many baskets, several kinds of plants sprang up, and such as grew usually in the soil where he made the experiment; and it is remarkable that clayish ground did bring forth one sort, the Puteolan mould another, gravelly earth another; and the same author adds that, in the island of Crete, whithersoever a man shall carry the earth, unless something else be sown therein, it brings forth cypress. In woods where, though oak, ash, beech, &c., may be propagated by acorns and seeds, brought thither by birds, yet that the willow, and almost an innumerable variety of other plants, which do not seed at all, (at least, which are not meat to birds, as the others are,) should spring up in the manner we see them, can be owing only to *spontaneous generation;* that is, to principles lodged in that earth, from the first origin and foundation of things: and thus have I ventured to give my thoughts on this important subject;

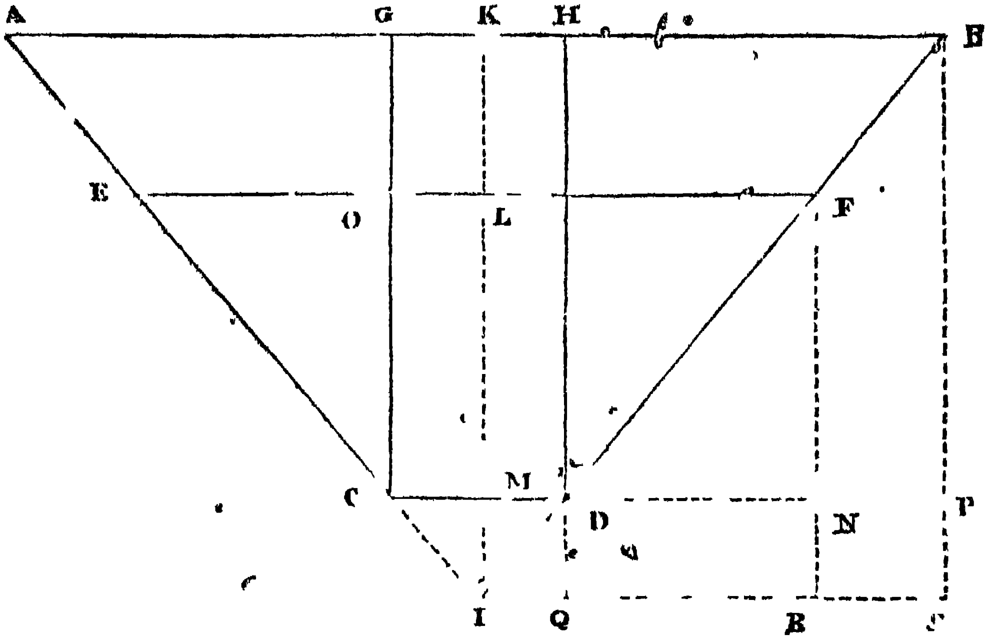
not with any intent to detract from the stupendous and eternal works of Providence, but to shew how agreeable this principle is, as I think, to the determination and decree of the Almighty, viz., that all kinds of earth should be impregnated with seminal rudiments, proper for the soil in which they grow, and which have been lodged in it from the creation of the world

THOMAS TAYLOR.

117, *London Road.*

QUERY No 94 Vol II Page 319

CONTENTS OF A RESERVOIR



1st Let the Trapezium, A B C D, represent one end of the cistern, A B the breadth at top (40), C D the breadth at bottom (8), and G C, H D the perpendicular depth (20)

2d Construct the Parallelogram G B P C, making the triangle B P D equal to the triangle C A G, then will the Parallelogram G B P C be equal to the Trapezium A B C D.

3d Produce A C and B D to meet in I, and erect the perpendicular K I Draw I S and S P, then will the square K B S I be equal to the Parallelogram G B P C added to the triangle C D I = M D Q I.

Then, as A G = 16 is to G C = 20, so is A K = 20 to K I = 25

Half A B + half C D = 20 + 4 = 24, and 24 × K M (= 20) = 480 = Area at the end, and 240 = half the area.

K I 25 × I S = 20 = 500 = true area + M D Q I = 20

Then to find the depth of one-half L M, it will be, as 500 : the contents of K B S I, is to 625 the square of K I, so is 260 (500, less the true half 240) to 325 = the square of I L, whose root is = 18.027756377, from which subtract M I 5, remains L M = 13.027756377, which subtracted from K M = 20, leaves 6.972243623 = K L, the depth of water the first party must pump out, and L M, the depth of water left, when the first half is pumped out To find the price of pumping, 480 × 200 = 96000, the contents in cubic feet = 2451.06 tuns = £30 12s 7½*d*, at 3*d* per tun

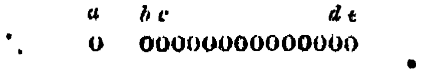
T H—— H.

[In addition to the above answer, by the proposer of the question, we have received another, from G Morley, which gives nearly the same result, but does not sufficiently exhibit the mode of ascertaining it —ED]

QUERY, No 112, Vol II Page 383.

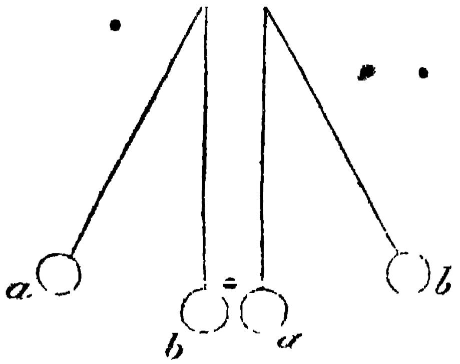
MOTION COMMUNICATED TO MARBLES, &c.

SIR,—Being no great mathematician or mechanic, I hope you will make every allowance for any inaccuracy in my attempt to give the explanation required by HOLLANDICUS By the third law of motion in mechanics, we are informed, that "to every action of one body on another, there is an equal and contrary re action" Thus, supposing the marbles to be of equal weight, the first marble, *a*, (in the following figure,) striking against the second, *b*, supported by the weights of the others behind it, will lose its motion by communicating it to *b*:—



b, in like manner, communicates it to *c*, from which it passes to the others in succession, till the last marble, *e*, receives the propelling force from *d*; when there being no repellant, or re-acting body beyond it, to oppose the force impressed upon it by *d*, the last marble is unavoidably forced away from the rest. The same effect must take place, if two or more marbles are the propellants, their weight being equal to that of the same number at the opposite end.

As this is a very interesting and instructive subject, I trust I shall be excused for subjoining a further illustration. The third law of motion may be exemplified in a manner somewhat analogous to the above, by suspending two ivory balls, of equal weight, by threads, in the manner represented in the figure:—



Now, if the ball, *a*, be lifted a little out of the perpendicular, and let fall upon *b*, the former will lose its motion by communicating it to the latter, and will remain at rest in the perpendicular, while the ball, *b*, will be propelled to a distance equal to that from which *a* fell; thus proving that the re-action of *b* is equal to the action of *a* upon it. The same effect will be produced with three, four, or even ten balls; or eight balls may be suspended in a similar manner, and three of them let fall against the rest, when those three and the two in the middle will remain stationary, while the three last will fly up to a height equal to that from which the others fell. A little reading on this subject would, however, be advisable, and it will be readily understood by consulting any treatise on Mechanics.

JUVENIS ADMIRATOR.

QUERY, No. 72, Vol. II. Page 255.

METHOD OF JAPANNING LEATHER.

White Japan.—This japan, which never changes its colour, and which absolutely withstands all the chemical agents that blacken other white pigments used in japanning, is obtained in the following manner. Let some artificial carbonate of barytes * be ground up with a sufficient quantity of white oil varnish, and apply it successively upon the leather; this being done, the finishing coats are given to the article with a japan composed of carbonate of barytes ground up with white copal varnish, and when perfectly dry, the leather is polished with a piece of felt, and finely levigated pumice stone powder, and the last or finishing polish is applied by means of a spunge or soft brush, and burnt heartshorn powder.

Yellow Japan.—To obtain a clear transparent yellow, the leather must of course be white, and a yellow dye is given to it by means of *woad*, or French berries, and alum; and when perfectly dry the japan ground of patent yellow is applied in the manner stated above.

Red Japan.—For this purpose the base of the japan ground must be made up with madder lake, ground up with oil of turpentine; this forms the first ground; when perfectly dry, a second coat must be applied, composed of lake and white copal varnish; and the last with a coat composed of a mixture of copal and turpentine varnish mixed up with lake.

Blue Japan.—The first coat must be given with artificial carbonate of barytes ground with oil varnish; the second with Prussian blue, ground in copal varnish, and finished as before stated.

Black Japan.—This is obtained by applying finely levigated ivory black, ground up with linseed oil varnish; the second coat must consist of the same pigment ground up in copal varnish.

S. HOLLANDS.

QUERY, No. 1, Vol. III. Page 13.

YEAST.

SIR,—Your correspondent wishes to know, if all the yeast used by the bakers in London, is supplied by the brewers of beer.—No; not above half. Great quantities of it is made from malt and hops, for which I have given the receipt below. Most of the brewers' yeast that is made use of for the making of bread in London, comes from the country; and the best from Birmingham, where the publicans generally brew their own beer. The London strong beer yeast is quite unfit for the making of bread; and the yeast from the small beer brewers is not much better. Were it not for the fermentation from potatoes, I do not know what the London bakers would do—I mean those that do not use the composition from malt and hops; many of them do not like it from its affinity to acid. The manner of using the potatoes, is by boiling them well, and rubbing them through a strainer, to take the skins and roughness from them: the quantity used, is about 2 lbs. to the 56 lbs. weight of flour; when properly cleaned, add a smaller proportion of brewers' yeast than what would be wanted to your sponge without the potatoes; put a handful or two of flour amongst the liquor, and let it stand for two hours before it is put in the trough for the day to work. This makes much the best and sweetest bread.

---

* Obtained by decomposing, or pouring into a solution of native carbonate of barytes, a saturated solution of sub-carbonate of ammonia.

COMPOSITION YEAST.

One peck of malt, and 8 ounces of hops. To the hops, put 12 quarts of water, to stand in the oven three hours, then strain off; and to the same hops, add 12 quarts more water, to stand in the oven the same time as before. To the liquor taken from the hops, put the malt (not scalding hot); let it stand three hours, then strain it off, and put the second liquor from hops on the same malt, to stand three hours as before. Then strain off, and put altogether; then add the store to it to ferment twelve hours, when it will be fit for use.

N. B.—Take care to keep 2 quarts, as store to ferment with, when you make. The first store may be brewers' yeast.

The above yeast requires to be worked cooler than brewers' after the first sponge. Four quarts will be sufficient for two sacks of flour. T. H.

Great Mary-le-bone Street,
Portland Place.

QUERY, No. 7, Page 30.

TO PREPARE PRINTS FOR COLOURING.

Dip the paper or print in a solution of alum; when dry, repeat the dipping, which, continue, till it will no longer absorb the liquid. This is a process to which I have frequent recourse, and which answers extremely well,—if, however, any of your correspondents can inform me of a more expeditious, efficacious, or simple process, they will oblige

Yours, respectfully, W. B. jun.

QUERY, No. 10, Page 30.

TO STAIN WOOD RED.

Take 2 oz. of Brazil wood and 2 oz. of potash; mix them with a quart of water, and let the composition stand in a warm place several days; frequently stirring it. With this liquor, brush over the wood, till the desired depth of colour is obtained. Then, with another brush, brush over the wood, while yet wet, with a solution of alum, in the proportion of 2 oz. of alum to a quart of water.

For a pink or rose red, use double the quantity of potash.

TO STAIN WOOD BLACK.

Brush the wood over with a hot decoction of logwood; then, several times with common ink.

To make a very fine black, brush over the wood with a solution of copper in nitric acid, as for blue, and afterwards with logwood, till all the greenness of the copper solution is gone. Or this,

Drop a little sulphuric acid (oil of vitriol) into a small quantity of water; rub this well into your wood; then hold it to the fire until it becomes a fine black, and when polished, it will be exceedingly beautiful.

Yours, respectfully, W. B. jun.

TO CORRESPONDENTS.

Mr. Johnson's communication has been received, and will be attended to in our next Number.

The suggestion of H. Campbell will be adopted when the subject referred to is resumed.

R. E. C.'s Query has already been proposed and answered. See Vol. I. page 319; Vol. II. page 416, &c.

The Question attached to Albert's letter will receive a satisfactory answer in our next. It has been already asked by another correspondent.

"A Constant Reader" has inadvertently introduced a word into his Letter, which we cannot exactly reconcile with one of his assertions. If he is entirely unacquainted with the gentleman alluded to, how is it that he appears to know his age so well?

An Architectural Draughtsman's Letter is intended for insertion.

T. L. will readily obtain the information he requires by applying at the office of the Institution in Southampton Buildings. His Query is not adapted to our work.

W. F. is mistaken in his conjecture.

Communications have been received from A Subscriber—An Old Engineer—Sophos—Not a Mechanic—Juvenis Admirator, &c.

London: Printed by R. G. GUNNELL and Co., Crown Court, Fleet Street.

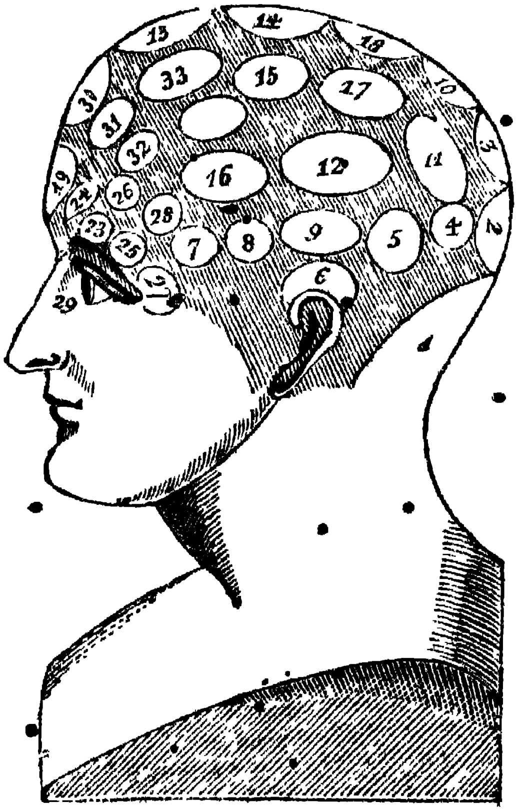
THE LONDON
MECHANICS' REGISTER.

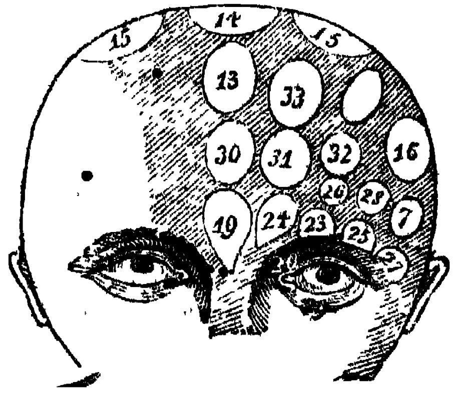
> "GOD has, for the well-being of Society, provided man with certain feelings and constitutional principles of action, which lead him to a conduct beneficial to those around him. Now, these are the principles which, scattered in various proportions among the individuals of human kind, give rise to the varied hues of character among them."
>
> DR. CHALMERS.

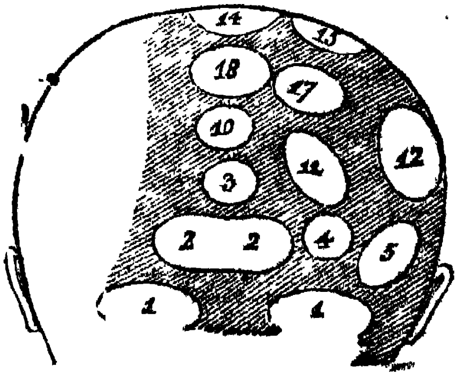
No. 60.] SATURDAY, NOVEMBER 19, 1825. [Price 3*d*.

PHRENOLOGICAL BUST,

ACCORDING TO THE SYSTEM OF DRS. GALL AND SPURZHEIM,







OUTLINES OF PHRENOLOGY.

In compliance with the wish of several of our Correspondents, who were interested by the perusal of **Tyro**'s first paper on *Phrenology*, we have given, in the present Number, an Engraving, illustrative of the relative situations of the various organs particularized in the Phrenological system of Drs. **Gall** and **Spurzheim**. The drawings have been very correctly taken from a bust, presented to the London Mechanics' Institution by a late Member of the Committee, and will form an interesting addition to our intelligent Correspondent's Abstract of Dr. Spurzheim's description of the organs enumerated in this "comical science," as **Tyro** calls it. The bust is accompanied by a descriptive pamphlet, published by Mr. De Ville, of the Strand, in which it is stated, that "the inconvenience of a method, that might tend to mislead the young observer, has been avoided, by merely putting a circle or oval, according to the shape most usually assumed, on the *centre* of each organ. By not attempting to define the *exact boundaries*, the student will no longer be disappointed in his expectations of finding an elevation, with the *exact linear figure and dimensions* of the spaces marked out on the busts that have been usually in circulation. The lines which inclose the figures of reference, do not, therefore, describe the *exact boundaries* of the organs, but are placed over the centres of each, as nearly as it was possible to do it in an artificial head."

In order to render the illustration as complete as possible, we have given three views of the bust, by which means the precise situation of all the organs will be clearly understood. In the bust, the number 29, which points out the organ of "language," is placed *on the eye-ball;* and, it is observed in the pamphlet, that "the larger or smaller developement of the portion of brain situated on the posterior part of the frontal bone, is indicated by the greater or lesser degree of *prominence* of the eye."

Our readers will doubtless observe, that in the profile and front views of the bust, one of the ovals appears blank, and we therefore think it necessary to extract from the pamphlet to which we have alluded, the following remarks on this *hiatus* in the phrenological system:—"There can be no doubt that an organ *does exist* in this quarter of the brain, intimately connected with numbers 15 and 16, *(Hope and Ideality)* and which seems to give a turn for the supernatural; when large, the persons have visions, are fond of the mysterious; and all miraculous stories, disbelieved by the generality of mankind on account of their improbability or impossibility, afford them a rich banquet; romances, over which a mystical cloud overshadows the agents and events, are their favourite books. It seems, both from its situation and from observations, intimately connected with religious feelings, but facts (at least in our own cases) are wanting to allow more latitude of opinion; and, as yet, its special faculty and sphere of activity are not ascertained."

With these preliminary remarks, we submit to our readers our correspondent's second paper, as follows:—

DESCRIPTION OF THE ORGANS, CONTINUED.

10. **Self-Esteem**.—This is a fundamental feeling, which gives to man a disposition to think well of himself; and when this feeling is strong, it amounts to *pride*. It is necessary to preserve individuals from lowness of mind;—a noble mind is always possessed of some self-esteem.

11. **Love of Approbation.**—Some people will do any thing, so that the world will notice them, and in such persons we always find this cerebral part large. This fundamental feeling is very evident in children, and is encouraged among them by the name of *emulation*.

12. **Cautiousness**.—Some people are remarkable for their timidity and hesitation, who never come to a resolution; they think of doing something, but do not act; in such, this organ will be easily discovered. In women, it is generally large.

13. **Benevolence.**—This feeling disposes us to be kind to others, to assist them in distress. What are called kindness, benignity, compassion, hospitality, good nature, are so many manifestations of the feeling. This organ is confirmed,

both in animals and men. If we examine such dogs as are mild in their tempers, we shall find their heads more raised, than the heads of those that are very mischievous.

14. **Veneration**—Is said to give rise to feelings, called moral and religious; to pay respect to beings around us, and pay veneration to supernatural beings or saints. It is, therefore, sometimes a moral, and sometimes a religious feeling. When applied to superior beings, it is called '*adoration*;' and when applied to beings around us, it is called '*respect*.'

15. **Hope.**—Some people are continually scheming—building castles in the air: they think, and immediately begin to act, without reasoning—without caution; they form plans, and think they must be immediately realized. There are others, who so easily despair, that they never hope—and between these, we shall find a great difference in the developement. It is a feeling necessary in every situation, for what would a man be without hope? It is this power which disposes man to hope for a future life; that gives him a "longing after immortality." we are so often deceived in this life, that we hope for something better in another.

16 **Ideality.**—This power gives practical talent. If we look to the organization of poets, we find them broad here. Still all men that are broad here are not poets; for poetry is the result of a great combination of powers, and there is something very peculiar in it. There should be a certain warmth of feeling, an exaltation of mind, not merely to describe things as they are, but to give the description a tinge beyond what is real—there must be a little fiction. It is a feeling which disposes men to become unhappy, since it induces them rather to look at things as they ought to be, than at things as they are.

17. **Conscientiousness.**—There is a natural feeling, which makes us look up to our actions with a desire of doing justice, and this feeling is called conscientiousness. It is the basis of all legislation; for without this fundamental feeling, of looking for justice, no laws could have been made.

18. **Firmness.**—Persons possessing this organ well developed, have generally a strong desire to exert authority, and to speak with great decision. It is the basis of the love of independence. It gives perseverance. If the power goes alone, then stubbornness and obstinacy are the results.

19. **Individuality.**—It is the power by which the mind acquires a knowledge of the *existence* of objects.

20. **Form.**—It is the knowledge of the *form* of objects. There are some persons who have great talents and taste in forms, and others who are almost insensible to them. Thus we have a familiar example in the French nation, who are more sensible to form than the English. This power is essential to portrait painters and to sculptors.

21. **Size.**—This organ gives a knowledge of the *size* of objects, and is supposed to be placed above the preceding organ. An artist may have made a form, and when we look at it, we see there is no proportion.

22. **Resistance, or Weight.**—There can be no doubt that there is a peculiar cerebral part by which we judge of the weight, resistance, and momenta of bodies. The organ is not, however, clearly ascertained, and its number, as well as that of the preceding organ (*Size*), is not marked in the bust.

23 **Colour.**—Those who excel in colouring have their eyebrows arched; and when we see the eyebrow to be more drawn towards the external angle of the eye, we may be sure of the organ.

24. **Locality.**—The knowledge of places, and the talent of judging of their relative situations, belong to this one fundamental power. Many persons shew a very strong local memory; they remember every place they have seen, and others can never find their way. Pigeons and dogs possess this organ, and manifest the greatest power in knowing places, as do many other animals.

25. **Order.**—Some people are much disposed to set every thing in its place, while others scatter them about in a most "admired disorder;" now, the first of these will have the organ full.

Tyro.

Rye.

LONDON MECHANICS' INSTITUTION.

MR. COOPER'S

SEVENTH LECTURE ON CHEMISTRY.

AMMONIA—PROCESS OF PROCURING IT IN A FLUID STATE—MANUFACTURE OF SAL-AMMONIAC—AMMONIA IN A GASEOUS STATE—ITS ABSORBABILITY BY WATER—ITS COMPOSITION AND SPECIFIC GRAVITY—COMBINATIONS OF AMMONIA WITH OTHER SUBSTANCES—

FORMATION OF SALTS—MURIATE AND CARBONATE OF AMMONIA—MODE OF ASCERTAINING THE PURITY OF AMMONIACAL GAS, &C.

FRIDAY, NOVEMBER 11TH.

Ammonia, observed Mr. Cooper, on commencing this evening's lecture, is a substance, of which the existence was known to the early chemists, as it is mentioned in Basil Valentine's book; and also by Raymond Lully and other chemists, anterior to them. They were, however, only acquainted with *ammonia* in combination with water, and other impurities; and the mode in which they generated it was, by the distillation of animal matter in close vessels. The substance generally employed for the production of *ammonia*, in this country, is *bones*, which are distilled in an iron retort or cylinder; and the result of this dry distillation, as it may be called, is a very considerable quantity of fluid matter, consisting of *fluid ammonia*, combined with other substances. This fluid may also be obtained from other kinds of animal matter, such as horns, hoofs, &c.; and the process for procuring it, may be seen in the apparatus now exhibited to the audience.

Mr. Cooper here directed the attention of the Members to the furnace, in which was placed an iron vessel with a stone head, to which was attached a large vessel of glass to receive the product of the distillation. The Lecturer removed the glass vessel to the lecture table, and observed that the brown fluid which it contained, was an *ammoniacal solution* in water, in addition to which, the interior of the vessel was lined with the salt called *carbonate of ammonia*, which resulted from the union of *ammonia* with the *carbonic acid* generated during the process. The reason of this double product is, that the quantity of water formed is not sufficient to hold the whole of the carbonate of ammonia, in solution, a portion of which unites with the carbonic acid, and crystallizes on the sides of the vessel. A portion of the fluid product being poured into a smaller vessel, it soon separated itself into two parts; the upper portion being *animal oil*, and the lower *a solution of ammonia in water*, with a slight admixture of the *animal* oil. The lowermost portion is analagous to the substance commonly called *spirits of harts' horn*, which is generally produced by the distillation of *bones*, though it is also procured from *harts' horns*; not that there is any difference in the product, when the latter substance, from which the common name originates, is employed, but it is the practice at Apothecaries' Hall, to this day, to manufacture this solution of ammonia, which is called spirits of hartshorn, from the horns of deer. In short, it may be procured, not only from bones or horns, but from the refuse parings of skins, or from any other animal matter. Mr. Cooper here put aside the contents of the vessel before him, observing that, in a short time, the solution would become nearly pure, as to *limpidity*.

Another abundant source of *ammonia* is the liquor formed during the distillation of *coal*, for the production of inflammable gas. In this process, independent of the gas procured for the purposes of illumination, a quantity of tar and *ammonia* are distilled over; the latter not being in a pure state, but mixed with *carbonic acid* and *sulphuretted hydrogen*. If either this ammoniacal liquor, or the fluid produced by the distillation of bones, be subjected to decomposition, by means of an *acid*, the substances with which the *ammonia* is contaminated are got rid of, and it becomes neutralized by the acid. Mr. Cooper here added a portion of *sulphuric acid* to some of the fluid contained in a retort, and the instant the acid came in contact with it, a rapid chemical action took place, and a large quantity of dense vapour was given off; the *sulphuric acid*, by entering into combination with the *ammonia*, had formed a *sulphate of ammonia*, while the *carbonic acid*, and *sulphuretted hydrogen gases*, escaped. That a considerable evolution of the latter substance had accompanied the experiment was indeed obvious to the olfactory nerves of the audience. By adding more *sulphuric acid*, the complete decomposition of the fluid would be effected, and the whole of the *ammonia* would become perfectly saturated. It will be perceived that the clear brown liquid employed in the experiment has lost its transparency, and become converted into a dirty-looking opaque fluid. In this case, only a partial decomposition had taken place, and the fluid must, therefore, be considered as a partial *sulphate of ammonia*. The next process employed by the manufacturer of this substance, which is extensively employed in the arts, is to separate the opacity, arising from a deposition which is readily effected by subsidence or filtration, and a colourless solution of sulphate of ammonia is ob tained, which is afterwards concentrated, by distillation to dryness. If *muriatic acid* had been used, instead of *sulphuric acid*, upon the present occasion, the result would have been *muriate of ammonia*, or *sal-ammoniac*.

Till within the last half-century, nearly all the *ammonia* used in Europe was brought from Egypt, where it was prepared by sublimation, from the soot produced by burning the dung of the camel. The dung of any other animal, if subjected to incineration in a chimney, leaves a soot, which, if put into a proper vessel, and subjected to heat, produces *ammonia* by sublimation. The process adopted in this country, is to subject the sulphate of ammonia to decomposition by means of common salt. In this operation, a double decomposition takes place, the *muriatic acid* of the common salt passing over to the *ammonia*, while the *sulphuric acid* of the *sulphate of ammonia* seizes the *soda*; forming respectively, *muriate of ammonia* and *sulphate of soda*.

Mr. Cooper exemplified this process, by mixing the *sulphate of ammonia* with *common salt*, and observed that this operation would convey an idea of the manufacture of *muriate of ammonia* on a small scale. Its manufacture in large quantities, is conducted in a manner analogous to the process exhibited in this experiment, but it is performed in large iron vessels, the tops of which are open, and are covered with earthen heads, to the interior of which the *muriate of ammonia* attaches itself. The Lecturer here produced a large cake of *sal-ammoniac*, about two inches thick, which had been manufactured in the manner described, and bore the curved form of the earthen head, from which it had been separated. Having thus procured ammonia in a concrete state, in combination either with *muriatic* or *sulphuric acid*, all the other combinations of *ammonia* may be effected by means of these substances, the further consideration of which may be deferred, till we have occasion to speak of their application to the arts and manufactures, and we shall therefore proceed to treat of the nature and properties of *ammonia*, in its distinct and uncombined state.

Ammonia, in a pure gaseous state, as well as its combinations with other bodies, may be procured by the agency of the substances already alluded to. Its existence as a distinct substance, is of comparatively recent discovery, for which we are indebted to Dr. Priestley, though it had been so long known in combination with water, &c. and it was Dr. Black who discovered the difference between *caustic ammonia* and *mild ammonia*, which are now distinguished by the names of *ammonia*, and *carbonate of ammonia*.

If either *muriate* or *sulphate of ammonia* are mixed with an equal quantity of perfectly caustic *lime*, and exposed to the action of heat, a large quantity of *gaseous ammonia* will be evolved. Mr. Cooper here mixed a portion of *muriate of ammonia* and *quick-lime* in a retort, and applied heat to it, the effect of which, he observed, would be, that the *muriatic acid* of the *muriate* would be transferred to the *lime*, while the volatile alkaline substance, *ammonia*, would escape in the form of gas. It is necessary to receive this gas over mercury, as it will presently be seen, that it is more rapidly absorbed by water than any other gas. What is generally denominated *ammonia*, is a solution of *ammoniacal gas* in water, in which form it is generally employed for chemical purposes.

A solution of *ammonia* in water is prepared by distillation, in an apparatus analogous to the one now exhibited, by mixing 18 parts of *lime* with 24 of *muriate of ammonia*, and 21 of *water*. The Lecturer here introduced these substances into a retort, in the proportions specified, and connecting the beak of the retort with a proper receiver, he applied heat to the mixture, and the *liquid ammonia* was distilled over accordingly. If it be wished to obtain a solution as highly concentrated as possible, the receiver should be surrounded with ice, snow, or some artificial freezing mixture; but it is bad economy to concentrate it too highly, as the stoppers of the vessels into which it is put are apt to be displaced, in which case, the volatile ammonia flies off. By the process now adopted, the specific gravity of the solution obtained, is about .950; which is as strong as it can be conveniently kept. Mr. Cooper here adverted to an error into which the young chemical practitioner is liable to fall, by applying heat too suddenly. This fault had, in the present instance, occasioned a partial defect in the experiment, for the sudden evolution of *ammonia* caused by the application of the heat, had thrown a part of the contents of the retort into the receiver, and, in some degree, contaminated the product. It is also economical to connect with the apparatus, by means of a tube, a second receiver, containing a small quantity of water, which will become impregnated with the gas which may escape during the distillation.

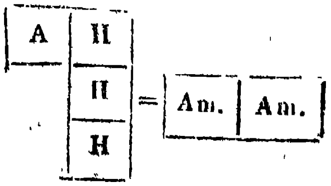
One of the properties of *ammonia*, in

its gaseous state, is its extremely pungent smell. When perfectly undiluted, it occasions speedy suffocation, as any animal confined in it dies instantly. To those who are in the habit of collecting insects for entomological purposes, it may be as well to observe, that this gas affords a ready method of destroying those little animals. A mixture of a small quantity of *sal ammonia* and *quick-lime* always produces an atmosphere of *ammonia*, and if a gauze box, containing the insects, is immersed in this atmosphere, they are dead in a second; and this method is far preferable to sticking them against the wall with pins.

Mr. Cooper now removed from the mercurial trough to the lecture-table, a cylindrical vessel, containing *ammoniacal gas*, which had been collected over mercury, as before described, by the application of heat to a retort containing *muriate of ammonia* and *quick-lime*. It has already been stated, that this gas is destructive of animal life, and the Lecturer shewed, that it is not a supporter of combustion, by plunging into it a lighted taper, which was instantly extinguished. It appears, however, to be in a slight degree inflammable, though not to such a degree as *hydrogen*, *cyanogen*, or *carburetted hydrogen*; that it is slightly inflammable is evinced by a faint halo which surrounds the flame of a taper immersed in it, and extends through the vessel, but it seems to require a very high temperature to effect its combustion.

Another property of *ammoniacal gas*, is its being considerably lighter than atmospheric air. If, therefore, a jar of this gas be opened with its mouth upwards, the gas soon disappears; the atmospheric air falling into the jar by its superior weight. Mr. Cooper removed the cover of the vessel which stood before him, and, in a few moments, introduced a lighted taper into it, which continued to burn, and thus demonstrated that the gas was displaced. This experiment led the Lecturer to the consideration of the composition and specific gravity of *ammoniacal gas*, which he illustrated by the following diagram:—

Ammonia.



$$\frac{29.65+(2.118\times 3)}{2}=18.00 \left.\right\} \text{Weight of 100 Cub. in. of Ammonia.}$$

30.5 : 1.000 : : 18.00 . .5902 Sp. gr.

By this diagram it is seen, that *ammonia* is composed of one volume of *azote* combined with three of *hydrogen*, and that the four volumes are condensed into two by their union. Therefore, to find the weight of 100 cubic inches of *ammonia*, 29.65 (weight of 100 cub. in. of *azote*) must be added to three times 2.118 (weight of the same quantity of hydrogen), and the amount divided by two, (the number of volumes,) which gives 18 grains as the weight of 100 cub. in. of *ammonia*. The lower statement in the diagram points out its specific gravity; for, as 30.5 (weight of air) is to unity, so is 18.00 (weight of ammonia) to .5902 its specific gravity, which is little more than half that of atmospheric air.

Another remarkable peculiarity of *ammonia* is its great absorbability by water, which is capable of taking up a very large quantity of this gas. To exemplify this fact, Mr. Cooper passed up a very small portion of water into a jar of the gas, standing over quicksilver in the mercurial trough, and though the quantity of water was merely an extremely small film, hardly sufficient to cover the surface of the quicksilver, the whole of the gas was absorbed in a short time, and the mercury rose till it filled the vessel. The quantity of ammonia which water is capable of absorbing, is differently estimated by different chemists; some of them stating it to be 460 times, and others as high as 700 times its own volume. Water, by its absorption of ammonia, has its volume considerably increased, and, consequently, the specific gravity of the ammoniacal solution is less than that of water. By ascertaining the specific gravity of the solution, the exact quantity of ammonia it contains may therefore be known; and tables for this purpose have been constructed by Sir Humphry Davy, Mr. Dalton, and Dr. Ure, all of which possess great pretensions to accuracy.

Ammonia is capable of entering into combination with a variety of other substances, with which it forms a class of bodies called *salts*. This is the first occasion which has presented itself for adverting specifically to this class of substances; and it may therefore be necessary to state, that what is meant by a *salt*, is the compound resulting from the combination of an *acid* with either an *alkali* earth, or a *metallic oxide*. All the alkalis may, in fact, be considered as *metallic oxides*, except the *volatile alkali, ammonia*; and if an *acid*, whether in a solid, fluid, or gaseous state, enters into combination with an *alkaline substance*, whether solid, fluid, or gaseous, the product, which may also possess either *acid* or *alkaline* properties, is a *salt*.

To illustrate the formation of a *salt* by the union of an *acid* with an *alkali*, Mr. Cooper directed the attention of his hearers to two glass vessels on the lecture-table, each of which was filled with a perfectly transparent gas. The one contained *ammonia*, and the other *muriatic acid gas*, and their respective quantities were equal. Upon applying the mouths of the two vessels to each other, so as to bring the two gases into contact, an immediate chemical action commenced, which was accelerated by inverting the vessels, and placing the ammoniacal gas below the muriatic acid gas; for the former, being the lightest, ascended, while the latter descended, and in a few moments the gases lost their transparency; and the vessels became completely lined with a dense white substance, formed by the combination of the two invisible gaseous fluids. During their union, a considerable quantity of heat was given out, in consequence of the gases giving up their elastic form, and becoming condensed into a solid substance. This substance is a *salt*, which, from the constituents of which it is composed, is called *muriate of ammonia*, and it will be found, on examining this solid compound, that it possesses neither *acid* nor *alkaline* properties. These gases unite in equal volumes to form muriate of ammonia, and the condensation which occurred during their union occasioned so great a vacuum in the vessels, that the Lecturer found some difficulty in separating them, as the pressure of the atmosphere attached them forcibly to each other.

Two other vessels were now produced, one of which contained *ammonia*, and the other *carbonic acid gas*, and their union, the result of which was also a solid compound, was effected in a similar manner. The *salt* formed in this experiment was, of course, *carbonate of ammonia*, of which there are three varieties, according to the proportions in which the constituents unite. The first is formed of equal volumes of the two gases; the second, of a volume and a half of carbonic acid to one of ammonia; and the third, of two volumes of the former to one of the latter. In the performance of this experiment, the great specific gravity of the *carbonic acid gas*, compared with that of the *ammonia*, was eminently conspicuous; for while the former occupied the lowermost vessel, the gases remained in contact, without any apparent chemical action; but the moment the vessels were inverted, the two gases passed rapidly through each other, and the opaque solid compound, formed by their union, immediately lined the interior of the vessels. Mr. Cooper combined the constituents of *carbonate of ammonia* in two different proportions, viz., in equal volumes, and in the proportion of two volumes of carbonic acid to one of ammonia; but observed that the intermediate compound, consisting of a volume and a half of carbonic acid to one of ammonia, which is called the *sesqui-carbonate of ammonia*, is the common carbonate of ammonia, sold at the shops in the form of *smelling salts*.

Mr. Cooper then blew through a glass tube into the vessels, in which the salts had been formed, in order to get rid of those portions of the gases which had not entered into combination. During this operation, a dense vapour arose from each of the vessels, part of which was inadvertently inhaled by the Lecturer, and evidently put him to some inconvenience. He shewed that the *muriate of ammonia*, (the salt formed by the union of muriatic acid with ammonia,) was soluble in water, and perfectly transparent; and observed that it would be seen, by the application of the ordinary test, that the muriate was *neutral*. It was probable, however, as there was an evident excess of muriatic acid in the present instance, that a slight indication of acid properties would remain. The Lecturer here alluded to the muriatic acid gas, some of which had got into his throat; and upon dipping a piece of litmus paper into the solution, its colour was changed by the acid which remained in the solution; but, upon adding a little ammonia, the blue colour of the litmus paper was instantly restored, and the neutral character of the solution was demonstrated.

To ascertain the purity of *ammoniacal gas*, it should be placed in contact with water, over quicksilver, in which case, if the gas be perfectly pure, the whole of it will be absorbed by a very small portion of water; but if any part of it remain unabsorbed, this residuum will denote the degree of impurity, which is indicated by employing a graduated vessel.

Mr. Cooper concluded, by observing that there were many other particulars connected with this substance, which he must defer till the next lecture, when he should resume the consideration of its nature and properties.

Dr. BIRKBECK, at the close of Mr. Cooper's Lecture, observed that he felt much pleasure in stating to the Members, that Mr. Reynolds, who was recently one of the Committee of Managers, and had also superintended one of the French classes, had kindly offered to give a gratuitous course of instruction in Geography and the Use of the Globes. Those Members who were inclined to avail themselves of this offer, would therefore furnish the Secretary with their names and addresses, and the numbers of their tickets. From the names thus given in, 25 Members would be selected, according to the periods during which they had been Members, provided they were not at present receiving instruction in any of the elementary schools. When a course of 12 lessons had been given to these Members, the next 25 would be selected in a similar manner, and so on till the whole of the applicants had partaken of this advantage.

The worthy President also observed, that a letter had been addressed to him, signed by an individual, with whom, if he were indentified with the signature he had adopted, viz., "Common Sense," he should be very happy to form an acquaintance. He had not yet had an opportunity of presenting this letter to the Committee, but he had no doubt that he might venture to say, that all that the writer proposed they would gladly see performed, if he would undertake it. The Doctor then read the letter as follows:

SIR,—As a Member of your Mechanics' Institution, I beg, through your influence, to mention an observation made by a country carpenter, who has lately attended one of Mr. Cooper's Lectures. He observed the great annoyance not only to the Lecturer, but likewise to the Auditory, from the continued noise by the slamming of the Pit doors, and expressed great surprise at the want of mechanical skill displayed by the Committee, and concluded they must have lost the sense of hearing. *(Laughter.)* He further observed, he would engage to remedy the evil for the sum of 20s., and recommended in the interim, that one of the Committee be appointed or requested to stand at each door to prevent the noise, *(great laughter,)* until such time as means are found to prevent it, from the commencement of the Lecture.

A number of other little things he mentioned that only require a few grains of common sense to rectify. These, however, will be left for their observation, as it would put a Committee selected from, say, 1600 *London Mechanics*, to the blush to point them out; they, however, will be mentioned if not attended to previous to next Quarterly Meeting.

I remain, Sir,
Your most obliged
And obedient humble Servant,
"COMMON SENSE."

The reading of this sapient epistle had a powerful effect on the risible faculties of the audience.

"Now," continued Dr. Birkbeck, "I am sure that if the '*Country Carpenter*' will present himself to the Committee, and perform this *sovereign* cure, (for you observe it is to be effected for *twenty shillings*,) [Loud laughter.] they, as well as the whole of the auditory, will feel greatly obliged to him. With regard to the *number of other little things* which 'Common Sense' threatens to bring before the Quarterly Meeting, it would be but charitable in him to communicate them to the Committee, as it would be much more convenient for them to '*blush*' in the Committee Room, than before all the Members." *(shouts of laughter.)*

As soon as the merriment of the audience had in some measure subsided, Dr. Birkbeck proceeded to express his regret that the numerous engagements of Professor Millington had prevented him from commencing his course of Lectures on Mechanics as soon as had been expected, viz. at the latter end of the last month. As these engagements rendered the precise period of their commencement a matter of some uncertainty, the President begged to offer his own services for two of the intervening Wednesdays, by which time it was possible that Professor Millington might be ready. On Wednesday evening next, he therefore proposed to exhibit a model of a large telescope constructed by an ingenious self-taught mechanic of Aberdeen, who was by trade a currier. This telescope the Doctor believed to be superior to any yet invented, except the celebrated telescope of Sir W. Herschel; and it even surpassed this, in point of mechanical arrangement. To render the subject more intelligible, he should prefix some observations on the telescope, a branch of the science of optics which had hitherto been but partially explained to the Members. On the following Wednesday he hoped to submit to them some other newly invented instruments, among which was a very curious piece of apparatus for laying down angles, and executing with accuracy all kinds of mechanical drawing, invented by Mr. Hart of Islington. One of these instruments had been presented by the ingenious inventor to the Institution, for the purposes to which it was applicable, and which the Members would find were of a very general and extensive nature.

This announcement was received with unanimous feelings of satisfaction, and the crowded meeting then separated.

LECTURES FOR NEXT WEEK.

Wednesday, November 23. Dr. BIRKBECK on various Mechanical Instruments, especially those of Mr. Johnson and Mr. Hart.

Friday, November 25. Mr. Cooper's Ninth Lecture on Chemistry.

WESTERN LITERARY AND SCIENTIFIC INSTITUTION.

A Public Meeting was held, on Thursday evening, the 10th instant, at the Freemasons' Tavern, Great Queen-street, which was numerously and respectably attended. At half-past seven o'clock, the Members of the Committee, and other gentlemen, who had taken an active part in promoting the Meeting, entered the room, when Henry Drummond, Esq., was unanimously called to the Chair. He was supported by Sir J. Paul, banker, Mr. Wright, banker, J. Cam Hobhouse, Esq., M. P., Mr. Thomas Campbell, H. Brougham, Esq., M.P., Peter Moore, Esq., M. P., Dr. Birkbeck, Dr. Golding, Dr. Grandville, Basil Montague, Esq., Dr. Mitchell, George Grote, jun., Esq., Dr. Maclean, and a number of other gentlemen.

The Chairman then addressed the Meeting in an able speech, in which he explained the objects of the proposed Institution; and concluded by stating that Sir John Paul, Sir Coutts Trotter, Mr. John Drummond, and Mr. Wright, had consented to accept the office of Trustees.

The First Resolution, declaratory of the advantages of Literary and Scientific Institutions, on a moderate scale of expense, was moved by Sir John Paul, and seconded by Mr. Thomas Campbell, the author of the "Pleasures of Hope," who delivered a speech which made a powerful impression upon the audience, and to which our limits will not allow us to do justice. His concluding observations were nearly as follows:—

"You associate for a purpose worthy of man, that was made in the image of his Maker [great applause]. Gentlemen, I feel that I may hasten to conclude my combat with the arguments of those who are the enemies of popular knowledge, for I find that their arguments fight most lustily against one another. At one time they tell us that knowledge will cease to be valuable, because it will be cheap and common, and therefore will cease to be a distinction. At another time, that this dog-cheap knowledge will render the people proud and insolent, and unwilling to work. Knowledge ceases to be valuable when it ceases to be a distinction!!! Why, what if our common people, if all but the rich had nothing but gritty bread to eat, and foul water to drink, and if it were suddenly brought about that palatable bread and water, pure as the diamond spark, could be brought to all our doors, what should we say of the man's sanity, who should exclaim—this is no blessing; for it will now be no distinction to have wholesome bread and water?—Is knowledge not intrinsically valuable? Is it a mere gaud and trinket to be worn for ornament? Is it not the staff of the human spirit? And as to knowledge making all men proud and discontented, let us be told which of the occult sciences it is, that will work this marvellous effect, in stultifying the human intellect and volition.—For, assuredly, all the knowledge that is commonly known, has a tendency to make men sober and reflective.—No, if every man, down to the paviours in the streets, were as learned as Voscius and Scaliger, still, while human beings require food and raiment, they must work; and to suppose the contrary, is to entertain the wildest chimera that ever entered the human brain. The enemies of popular knowledge tax the promoters of it with being visionaries; but I tax them, its enemies, with being the strangest visionaries on earth. Already the comparatively enslaved Continent has become ashamed of such prejudices. When I had lately occasion to visit Prussia, and witnessed the noble institutions for making learning accessible to the meanest of his subjects, which Frederic William the 3d has endowed, I felt, for the first time in my life, my breast pay a tribute, which a freeman's breast very seldom pays to an absolute prince in his own dominions—I felt a sensation of envy for Royal Power. Let me deprecate, in praising a foreign Monarch for founding Universities, the most distant intention of doing so at the implied expense of an august personage, against whom, if I were to touch the most oblique, latent, and invidious meaning, I should aggravate the meanness of disloyalty, by that of personal ingratitude [applause]. Besides, it would be absurd, as well as malignant; for that august personage has, no more than the Presidents of North America, the power of disposing of the national wealth, in founding Universities; though, to the extent of his means, he has been a liberal patron of arts and sciences, whilst the King of Prussia is the sole steward of all the money of his kingdom. But still, let me say, that the Institutions which his Prussian Majesty has founded for learning, have won him the gratitude of his own people, and deserve the admiration of the world.—But, thanks to Providence, the people of England can found all Institutions of this kind for themselves. Your metropolis itself is richer than the whole Prussian dominions; its dense population facilitates our taking counsel together; it cheapens apparatus, and books, and teachers; let us avail ourselves of these advantages. Combination, in the most virtuous sense of the word, is your watch-word; and, as numbers constitute power, let me hope that numbers will follow your good example. For my own part, I shall suffer no man to say within my hearing without contradiction, that this expression of the popular desire for information is a passing rage or fashion. No; it rises out of the natural sagacity of the English mind, ripened by time and circumstances; and I boldly augur, that the spirit of improvement now displayed, will be followed up with that steadiness which the world, in its rivalship with us in arts, and arms, has felt to be inherent in Englishmen. I greet your Association as a proof of reason being predominant in the public spirit, and I have only to exhort that you will

> ———————" On reason build resolve;
> That column of true dignity in man."

Mr. Campbell sat down amidst loud, continued, and general applause. The Resolution was carried unanimously.

The second resolution was moved by Mr. Wright, the banker, and eloquently supported by Mr. Hobhouse, who expressed his conviction that this, and all similar Institutions, would meet support from all those high-minded men of all parties who had the good of mankind at heart, unmixed with baser matter, and who strove nobly onwards, regardless whether their reward was the applause of their contemporaries, or the meed of fair and impartial posterity. Men could have no better means of wisdom than books, than those dead friends who never flatter, and are always present. Every man felt, he had himself felt, times when what had been written by the wisest of mankind gave a consolation and a hope nothing else could give. It had been said, by one of the greatest men of antiquity, Cicero, "that these studies are food for youth, and the consolation of age; they form the charm of private life, and add grace to society. They relieve the labours of the day, and they beguile the watches of the night."

Mr. Brougham, in the course of the eloquent address with which he prefaced the third resolution, observed that the Institution was for those who had part of their time occupied, and part unoccupied, and it would have a beneficial influence on the upper classes, or those who had all their time unoccupied, by stimulating them to make some exertion that they might receive a better education, and not be outstripped by others;—it would have a beneficial influence on the labouring classes, or on those who had scarcely any time unoccupied, by holding out to them encouragement and assistance, and by affording them, in fact, the means, and a stimulus to keep pace with this middle institution. The resolution which he had to propose embraced the objects of the Institution, and he hoped soon to hear of other great trading towns imitating the example of the metropolis, and establishing similar Institutions, as in the largest of them it was fully as much or more wanted than here.

The remaining resolutions were ably moved and seconded by Dr. Birkbeck, the Honourable Douglas Kinnaird, Mr. Peter Moore, M. P., G. Heath, Esq., Dr. Gilchrist, Dr. Mitchell, and other distinguishing characters; and the following gentlemen, viz.:—Messrs. Barwise, Benson, Bittleston, Carmichael, Hitchman, Jackson, Mitchell, Place, jun., Read, Ryan, Thompson, Tijou, and Watkins, were appointed as a Provisional Committee, with authority to take all necessary measures to promote the object in view.

Thanks were voted to the Chairman, Mr. H. Drummond, who acknowledged the obligation in suitable terms, and the Meeting separated soon after 10 o'clock. A number of gentlemen entered their names as Members of the Institution, which, from so auspicious a commencement, there can be no doubt will be successfully established.

MOISTURE IN THE ATMOSPHERE.

To the Editor of the Mechanics' Register.

SIR,—Although I think AMICUS might have ridden his hobby a little more courteously, I beg leave to ask him the particulars of the experiment in a sheltered situation, for to me there appears some difficulty in freeing it from the very cause I suggested, namely, the increase of velocity of the wind—however, if this experiment was fairly tried, and the result as he asserts, it would be conclusive against my suggestion, which was at any rate plainly, and I intended it to have been modestly expressed. To me, AMICUS is not quite so clear;—does he mean that the vapour, of which his shower of rain is formed, covers a greater superficial area than the rain when fallen? Even this would not account for much increase—the height of the upper gage being but small, compared with the usual height of the vapour. I am, Sir,

Your obedient servant,

S. E. ASH.

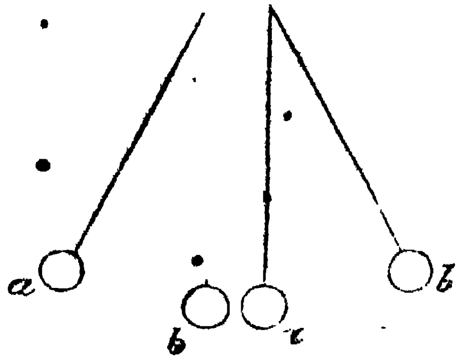
P. S. In answer to your correspondent, A JUVENILE PHILOSOPHER, I do not deny that the drops passing through a moist atmosphere may gather a little; but it does not appear to me, that the height of the tower is a sufficient space to enable them to collect much.—I shall be glad to hear the result of the experiment, which I have no doubt will be performed with due attention.

LAWS OF MOTION.

To the Editor of the Mechanics' Register.

SIR,—In page 383, Vol. II., a correspondent, HOLLANDICUS, proposed a query for the consideration of your readers, respecting the motion of round bodies, instancing marbles. To this query, your last Number contains a reply, by JUVENIS ADMIRATOR, who has also favoured us with a few additional remarks. On the first part of his communication I do not intend to offer any observation, but on the latter part, I shall take the liberty of commenting.

"The third law of motion," he observes, "may be exemplified in a manner somewhat analogous to the above, by suspending two ivory balls, of equal weight, by threads, in the manner represented in the figure:—



"Now," says he, "if the ball, *a*, be lifted a little out of the perpendicular, and let fall upon *b*, the former will lose its motion by communicating it to the latter, and will remain at rest in the perpendicular, while the ball, *b*, will be propelled to a distance equal to that from which *a* fell."

Now, Mr. Editor, it is very evident that *b* will fall from the height to which it has been carried; and striking upon *a*, will part with its motion, and "remain at rest in the perpendicular:" while, according to JUVENIS ADMIRATOR, *a* will be carried to its former elevation. Falling thence, it is quite clear the same series of motions will be repeated; and thus we have a *bonâ fide perpetual motion!* Really, Sir, you must allow me to congratulate your correspondent on his very brilliant discovery. His fortune is made, without doubt; and as you were the first to communicate the important intelligence to the public, you will, of course, be a sharer in his good fortune.* Sorry am I to interrupt, even by a whisper, those delightful, self-complacent dreams, in which he is, doubtless, indulging. Gladly, indeed, would I leave him to build castles in the air without disturbance, but that I am apprehensive they will topple about his ears, and, perhaps, bury him in their ruins. Allow me, then, to suggest to him the propriety of his *repeating* the experiment, if indeed he has ever performed it. By observing it accurately, he will possibly observe a slight difference between the altitude to which *b* rises, and that from which *a* fell. I need not say that the smallest variation in the result of the experiment will make a vast difference in the consequences to be deduced from it.

Your correspondent has, in the outset, modestly requested, that "every allowance may be made for any inaccuracy in his attempted explanation," on the ground of his being "no *great* mathematician or mechanic." Being fully prepared to give implicit credit to the truth of this remark, I shall not animadvert with severity on the discrepancy to which I have just alluded. A little reflection will suffice to convince him of the improbability of the fact which he asserts. Let him take into consideration the attraction of the earth, which opposes *b* in its *ascent*, but favours *a* in its *descent*. The slightest variation in the relative height of the balls, would, as I before observed, be fatal. For should there be the difference of only the one-thousandth part of an inch between the altitude which *b* attains, in comparison with that o *fa*, the defection would become more apparent at every vibration; the distance to which the balls would be thrown gradually diminishing, till they would both "remain at rest in the perpendicular."

It will not be necessary to do more than glance at JUVENIS ADMIRATOR's "three, four, or even ten balls." "Eight balls," he says, "may be suspended in a similar manner, and three of them be let fall against the rest, when those three and the two in the middle will remain stationary, while the three last will fly up to a height equal to that from which the others fell." I very much suspect the ability of your correspondent's balls, to take so high a flight.

"A little reading on this subject," he concludes, "would, however, be advisable." I hope your correspondent is by this time convinced, that such a course is "advisable," in another sense than that which, perhaps, he intended to convey. I am, Sir,

Your obedient servant,

N. R.

Nov. 12, 1825.

DIVIDING LINES.

To the Editor of the Mechanics' Register.

SIR,—Being a constant subscriber to your valuable Register, I was much amused at a novel. and, I think, rather a round-about way of dividing a given line, recommended by Mr. Davy, (Vol. II. page 368.) which, to be candid, I must confess is, in my opinion, superseded by the method given by H—Y P—E (in page 412), both for facility and accuracy. I have inclosed a diagram which, I think, will shew where the one is preferable to the other. Mr. Davy proposes drawing from a perpendicular line, (which is divided into as many parts as the given line requires) horizontal lines to an inclined plane, and then to let fall other lines parallel to the perpendicular line from the intersections on the inclined line, as shewn in the figure which accompanies his communication; so that the least variation from the points upon the divided line, will be increased upon the inclined line, and, of course, divide the given line very imperfectly. But, supposing the pupil to draw his horizontal lines very accurately from the points to the inclined line, even then, he is in danger; for every one knows, that, in practice, a line has *breadth*, and, where a horizontal line intersects an inclined one, that breadth is increased; so, that a learner, by using Mr. D.'s method, may fall into an error, on account of the breadth of the intersections.

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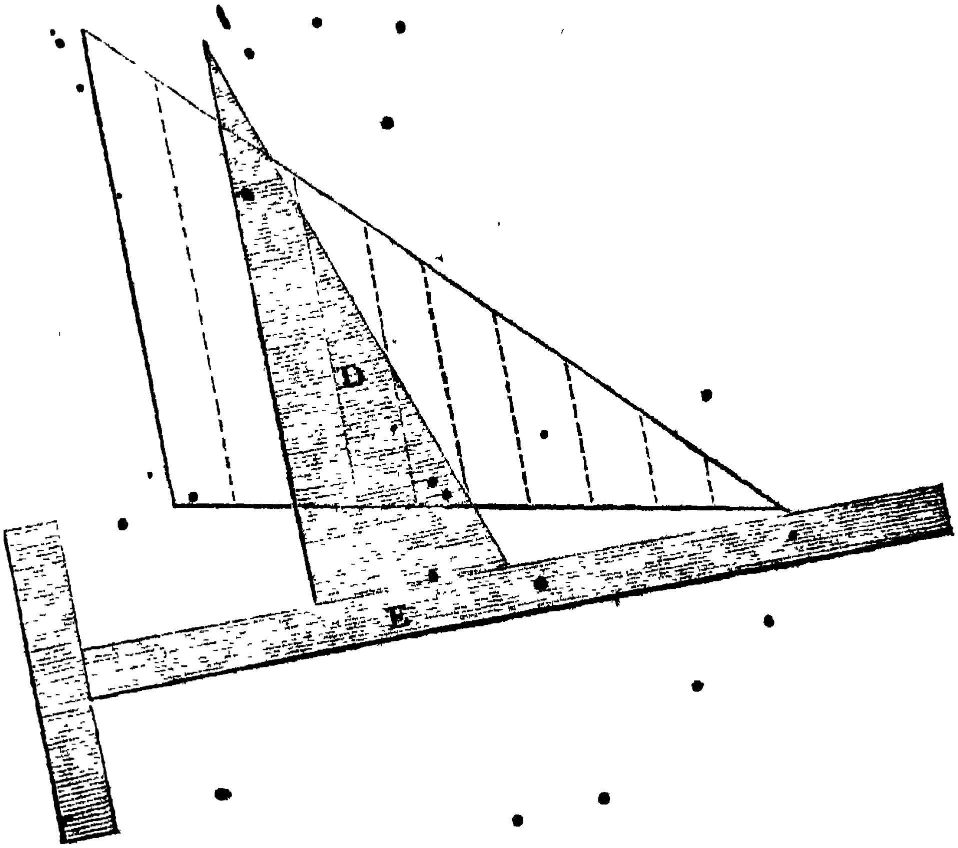
* We must, in candour, disclaim any right to a participation in the good fortune here alluded to, because we were quite innocent of any intention to communicate so important a discovery to the world. The fact is, that we gave Juvenis Admirator credit for knowing that the attraction of gravitation would prevent the second ball from passing through a curve exactly equal in length to that described by the first, and we therefore did not interpret his communication quite so *literally* as our correspondent has done.—ED.

Now, the method suggested by H——y P——e has not that fault, the lines being drawn direct from the compass point, to the line requiring to be divided, as shewn in the following figure:—



I should not have noticed either the one or the other, had not Mr. D. taken the matter up so warmly, as to deny H——y P——e the merit of suggesting a better method than his own. I think if Mr. D. looks at the figure, he will see that an inclined, or bevil line can be drawn as easily as a right angle, only by moving the square bodily, as shewn at F., and using a set square D upon the edge of the T square E, moving it at pleasure from left to right. As to the moveable stock, which Mr. D. speaks of, I do not approve of it; neither would I recommend it to any pupil of mine; for oftentimes the one side is taken for the other, and causes great confusion in a drawing, especially in inking in.

Should you favour these few remarks with a place in your valuable little work, I hope that Mr. D. will be convinced that a bevil line can be drawn with as much facility as a horizontal or perpendicular one, and quite as accurately. I seldom or never use a parallel rule myself, having accustomed myself to the set square, which in all respects is so much better.

I am, Sir, your's truly,

An Architectural Draughtsman,
and
Teacher of Perspective.

ANSWERS TO QUERIES.

QUERY, No. 87, Vol. II. Page 302.

EFFECTS OF CARBONIC ACID GAS ON THE ATMOSPHERE.

To the Editor of the Mechanics' Register.

SIR,—In the different arguments that have been used on the query of your correspondent, "That if plants absorb carbonic acid gas and give out oxygen, which is essential to health and life, how is it that large cities, where but very few vegetables grow, are not very unhealthy?"—it has been taken for granted that, because no animal can respire carbonic acid gas unmixed, without its proving fatal, that, therefore, in whatever proportion it is developed in the atmosphere, in the same degree it must be deleterious, and would soon preponderate to a degree to prove fatal, were it not for a wonderful provision of Providence, causing its absorption by vegetables, whose growth it promotes. However, not only is it taken up in this way, but it might have been added, that it is one of the most abundant materials in nature, entering into almost every animal, vegetable and mineral composition, for their *preservation*, not their *destruction*, and cementing together some of the largest masses of rock that compose our globe. Now, though oxygen-gas is known to be necessary to support human existence, yet neither is it to be respired *unmixed* for any length of time without producing, ultimately, the same fatal effects as the other; and it is only by its admixture with nitrogen and carbonic acid gases (for there is about 1 per cent. of the *latter* found in atmospheric air) that it becomes fit for supporting animal life. As Providence does nothing without a cause, it is, no doubt, for some wise purpose, that carbonic acid gas is superadded to it, and it shall be my purpose to shew, that in this view, and owing to its great *antiseptic* qualities, it answers a most important end.

It may be considered a bold thing for me, Mr. Editor, to assert; but, I am of opinion, that the air is more frequently deteriorated by *excess of oxygen* than by what is termed *fixed air*; and that, on the contrary, but for the quantity of the latter generated in great cities, by lime and brick-kilns, chimneys, &c. &c., they would scarcely continue, in this moist climate, to be habitable. When oxygen gas, or rather, *nitrous oxide*, for it cannot be respired pure, is taken in any considerable quantity, what effect do we see produced?—is it not a more violent and rapid circulation of the blood, as in fever, and if continued for any length of time, would not the same consequences ensue, wasting and decomposing the system until its final dissolution? It may be asked, in what way do I suppose *excess of oxygen* to be engendered in the atmosphere? and my answer, is, partly from what is given out by vegetation, but principally by moisture in close places, shut out from a free circulation of air—where the decomposition of animal substances is constantly going on, permitting the escape of sulphuretted hydrogen, and other deleterious gases, causing inflammatory and putrefactive diseases, destructive of life.

Fermentation (or otherwise decomposition of substances) is usually divided into three stages, viz., the *vinous*, *acetous*, and *putrefactive*. To produce it, moisture and heat seem necessary—a rapid action is seen to ensue, and during the first part of the process, the material that is liberated in greatest abundance is *carbonic acid gas*; a regular increase of temperature goes on, and when it has attained to about 70°. of Fahrenheit, (to the best of my recollection,) the acetous fermentation commences,—what remains being oxygen combined with some base to form the acid. Here I think there can be little doubt that the oxygen, as well as the caloric, seen to occasion the increase of temperature, are supplied from the moisture; and the substance driven off being carbonic acid gas, it would seem to follow from this, that if we could succeed in restoring to the substance what it had lost during the process of decomposition, we should have it again in its original state;—and this we find, in practice, to be founded in fact; for, it is well known, that to restore wine, in which the acetous fermentation has commenced, and it has become what is termed *pricked*, we have only to impregnate it with a portion of this gas. And the preservative qualities of *carbon*, also, in counteracting putrefaction in animal substances, is too well known to be insisted on here.

Such, then, is my proof, from all which, I am led to deduce, that oxygen being the acidifying and corroding principle, that actively promotes decomposition, it is therefore the most destructive in its effects, and that carbonic acid gas being the corrective to this—its dissemination in the atmosphere answers a most important purpose, and, instead of being deleterious, as is supposed, turns out to be a real blessing.

This I consider a new and important view of the subject, and, as such, you may probably deem it worthy of insertion in your interesting work, particularly as it answers, as I should suppose satisfactorily, the query of your correspondent. I remain,

Mr. Editor,
Your very obedient servant,
GMO. HENRICUS.
Leigh-street, Burton Crescent.

QUERY, No. 90, Vol. II. Page 302.

PERFORATION OF GLASS.

SIR,—In answer to the above query, permit me to inform your correspondent, that holes may be drilled in glass by using a *copper drill*, of the size of the intended hole, regularly supplied with *emery* and *oil*. The motion of the drill must be very rapid. I have been in the habit of removing the mandril from my lathe, and placing in its stead a small apparatus for drilling glass, consisting of a mandril to hold the drill, furnished with a very small pulley to produce the quick motion. A large drill may be made of a piece of thin copper, bent into the form of a tube, but the edges ought not to be brought quite close together.

I hope this answer will meet the eye of some mechanic who is better acquainted with the subject than I am, and who is sufficiently liberal to communicate his superior information; for the above is not the method which I know to be used by those engaged in that line of business, but only a plan which I have occasionally tried, and found to answer.

X. Y.

QUERY, No. 90, Vol. II. Page 302.

PERFORATION OF GLASS.

As it is well known that *fluoric acid* will corrode glass, and which is used by engravers upon glass for that purpose, I think, if your correspondent were to try it, he would find it answer his purpose, instead of using the diamond.

H. W. DEWHURST.

QUERY, No. 62, Vol. II. Page 237.

COURT-PLAISTER.

In answer to TYRO-MECHANICUS, I beg leave to refer him to page 143 of Vol. I., where he will find an excellent method of making court-plaister, which I sent in answer to a correspondent signing himself T, and which I hope will answer his purpose, as I can venture to recommend it from long experience.

H. W. DEWHURST.

QUERY, Vol. I. Page 62.

VARNISH FOR PLAYING-CARDS.

Let your correspondent give his cards a coat of the isinglass preparation, and, afterwards, three coats of the mastic-varnish, (as made from the prescription of your fair correspondent Miss Emma R****, Vol. I. page 143,) each coat being quite dry, previous to the next being laid on; by this method, the cards, when dirty, will bear washing, and afterwards may be polished by rubbing them with a soft dry cloth.

H. W. DEWHURST.

QUERY, No. 102, Vol. II. Page 282.

CASTING MEDALS.

To form the moulds, use plaster of Paris, as in stereotype-printing, and cast the medals with type-metal.

W. B. jun.

QUERY, No. 107, Vol. II. Page 382.

GILDING THE COVERS OF BOOKS.

To prevent the effect alluded to by your correspondent G. E. N., I would recommend the use of *tallow* instead of *oil*.

W. B. jun.

SINGULAR METHOD OF CATCHING FISH.

The following ingenious mode is said to be practised by the Chinese. To one side of a boat, a flat board, painted white, is fixed, at an angle of about 45 degrees, the edge inclining towards the water. On moonlight nights the boat is so placed, that the painted board is turned to the moon, from whence the rays of light, striking on the whitened surface, give to it the appearance of moving water, on which the fish being tempted to leap, as in their own element, the boatman raising the board with a string, turns the fish into the boat.

BOTANICAL OBSERVATIONS.

The viscous material which surrounds the stalks under the flower of the plant called the *catchfly*, is a contrivance to prevent various insects from plundering the honey or eating the seed. In the *dionæa muscipulæ* there is still a more wonderful contrivance to prevent the depredations of insects; the leaves are armed with long teeth, like the *antennæ* of insects, and lie spread upon the ground round the stem, and are so irritable that, when an insect creeps upon them, they fold up, and crush or pierce it to death. The flower of the *arum muscivorum* has the smell of carrion, by which flies are tempted to lay their eggs in the chamber of the flower, but in vain endeavour to escape, being prevented by the hairs pointing inwards, and thus perish in the flower; hence, the name of *fly-eater*. In the *dypsacus* is another curious contrivance for this purpose; a basin of water is placed round the point of each stem. In the *drosera* is also another kind of fly-trap.

THE GYMNOTUS, OR ELECTRIC EEL.

This singular fish is a native of the river of Surinam, in South America; those which were brought over to England some years since, were between three and four feet long, and gave an electric shock to any person who put one finger on the back near its head, and another of the other hand into the water near its tail. In their native country, they are said to exceed twenty feet in length, and to kill any man who approaches them in a hostile manner. It is not only to escape its enemies that this surprising power of the fish is used, but also to take its prey, which it does by benumbing them, and then devouring them before they have time to recover; or, by perfectly killing them; for the quantity of the power seems to be determined by the will or anger of the animal, as it sometimes strikes the fish twice before it is sufficiently benumbed to be easily swallowed. The organs productive of this accumulation of electric matter have been accurately dissected and described by Mr. J. Hunter, in the *Phil. Trans.* vol. 65.

ÆROLITE.

At a sitting of the Royal Academy of Sciences in Paris, M. Humboldt presented to the Academy a fragment of a mass of meteoric iron, which was found in Columbia, at a short distance from Santa Fe de Bogota, near the summit of a mountain. The entire mass weighed 3500 pounds, and required great labour to remove it to the forge of a smith, who bought it for about five pounds, and who began by smelting a part of it with the intention of employing it for the uses of his trade. Having, however, found it too brittle for his purposes, he gave up the idea of working it, and even concealed the remainder of it through a fear lest his credit might be injured if it were known he employed such an inferior article. Fortunately an eminent naturalist, M. Humboldt's correspondent, having accidentally learned the secret, obtained the mass of iron and analysed a part of it. The result of this analysis, by proving the existence of a certain quantity of *nickel* mingled with the ore, has put the aerial origin of this mass beyond a doubt.—The ærolite, of which M. Humboldt has presented a fragment to the Academy, is one of the most curious mentioned in the history of science.

TO CORRESPONDENTS.

We shall take an opportunity of communicating with Mr. Jenneson on the subject of his plan, which requires some further explanation.

Mr. Johnson will excuse the postponement of his Letter, the engraving for its illustration not being completed.

A Constant Reader is informed, that there are several solutions of mercury, and he should specify which he means.

W. W. is intended for insertion. We have not yet been able to procure the Paper mentioned in his Postscript.

We very cordially return our friendly correspondent's *shake of the hand*, and shall be happy to have frequent opportunities of repeating the salutation.

We must take a little time to consider the singular subject, proposed for investigation by GMO. HENRICUS.

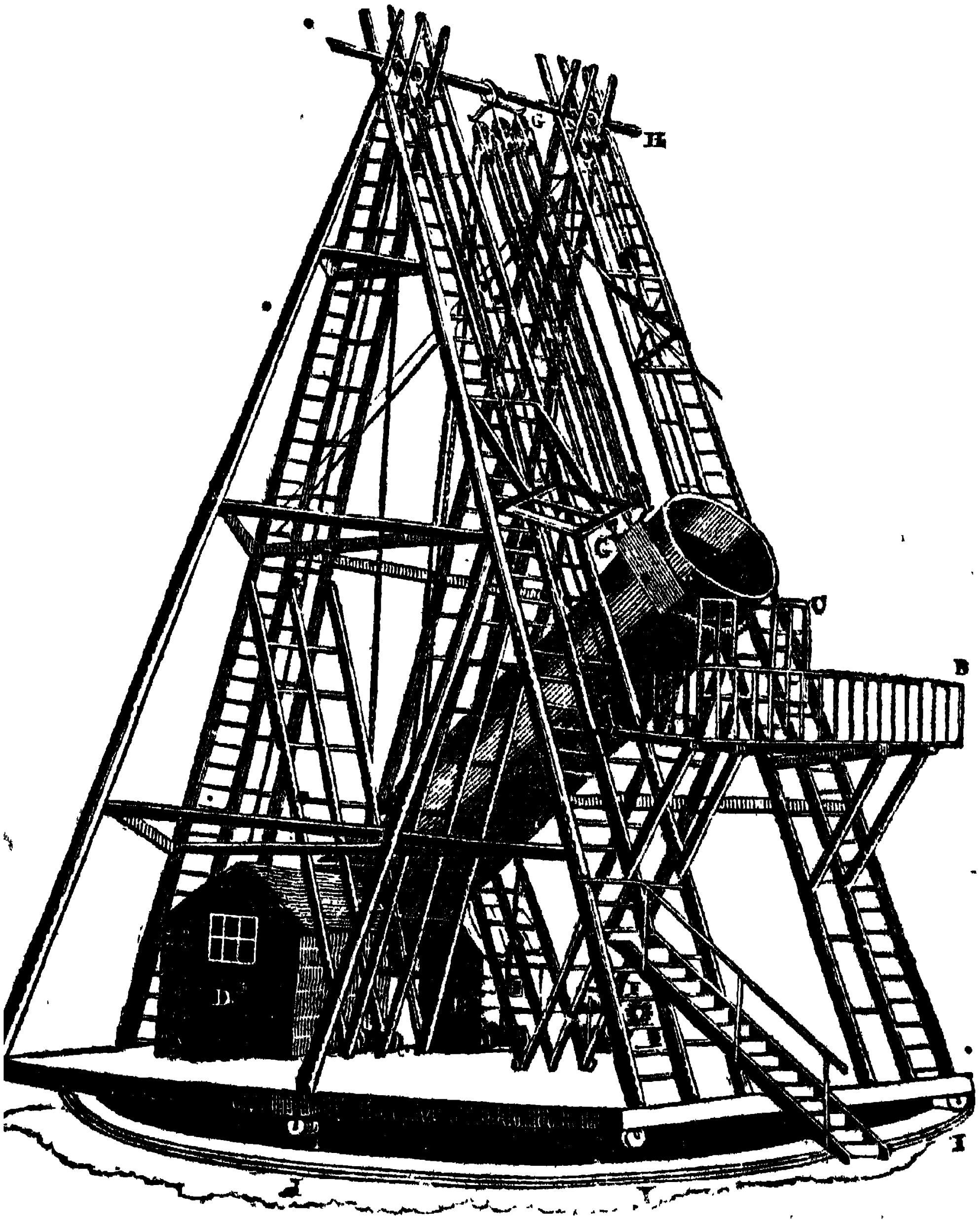
T. H———H—I. H. B.—S. P.—and several other Correspondents, will be attended to, as soon as possible.

THE LONDON
MECHANICS' REGISTER.

"Delighted HERSCHEL, with reflected light,
"Pursues his radiant journey through the night;
"Detects new guards, that roll their orbs afar,
"In lucid ringlets round the GEORGIAN STAR."
DARWIN.

No. 61.] SATURDAY, NOVEMBER 26, 1825. [Price 3*d*.

VIEW OF SIR WILLIAM HERSCHEL'S GRAND TELESCOPE.



LONDON MECHANICS' INSTITUTION.

DR. BIRKBECK'S LECTURE ON TELESCOPES AND MICROSCOPES.

INTRODUCTORY OBSERVATIONS ON LIGHT —PRISMS—ARTIFICIAL RAINBOW—LAWS OF OPTICS—REFLECTION AND REFRACTION—LENSES—REFRACTING AND REFLECTING TELESCOPES—MR. CUTHBERT'S TELESCOPE—HERSCHEL'S GRAND TELESCOPE—MR. RAMADGE'S TELESCOPE—MICROSCOPES—MR. CUTHBERT'S REFLECTING MICROSCOPE—SOLAR MICROSCOPES—CONCLUSION.

WEDNESDAY, NOVEMBER 16TH.

DR. BIRKBECK, agreeable to the notice he had kindly given, at the close of Mr. Cooper's lecture, on the preceding Friday, delivered this evening an admirable discourse on subjects connected with the science of OPTICS, which he introduced by observing, that one of the most elegant and interesting branches of philosophical enquiry, is that which has for its object the discovery of the nature and properties of *light*. Whether considered in relation to its *mechanical qualities*, displayed in producing the various modifications of vision, or in reference to its *chemical powers*, which maintain the bloom and verdure of the vegetable creation, and, in the most important manner, support the existence of respiring animated beings; *Light* must prefer peculiar claims to the attention of every enquirer, whose mind is directed to the contemplation of the phenomena of the material world. Yet, Optics, the science which involves these important objects, being little susceptible of popular elucidation by experiment, excepting in peculiar states of the atmosphere, and requiring the assistance of diagrams, which assume the alarming form of mathematical investigation, and, consequently, of dry, abstruse discussion, has not obtained that portion of estimation to which it is certainly entitled. When we recollect, that to *light* we are indebted for the largest and most diversified stores of information respecting surrounding existences, conveyed too with incredible rapidity, and accumulated from sources boundless as creation, we cannot fail, I feel persuaded, to become interested in possessing an acquaintance with its laws, and with the manner in which it becomes applicable to the purpose of introducing so much knowledge. Fully, we shall then be ready to admit, does its infinite excellence justify the apostrophe of the poet:—

> ——"Prime cheerer, Light!
> "Of all material beings, first and best!
> "Efflux divine! Nature's resplendent robe!
> "Without whose vesting beauty, all were wrapt
> "In unessential gloom."

If we examine the opinions of many of the most distinguished philosophers, who have investigated this curious and intricate subject, we shall find them representing the cause of the sensations, by means of which we perceive external objects to be *material;* but to consist of matter, rare and subtile, in the most inconceivable degree. This matter is by them stated to be projected from luminous bodies in *rays;* not consisting of particles situated near to each other, but with intervals of vast extent;[*] moving with a velocity almost incredible, and pursuing uniformly *a rectilinear course*, unless diverted from it by striking against bodies, or penetrating media, which interrupt their progress. It is obvious, therefore, although otherwise represented in our diagrams, that *light* is not believed to consist of *a continuous or unbroken stream of luminous matter*, but to be constituted of *separate unconnected atoms*, succeeding each other with great celerity; with that celerity indeed, which is requisite for preserving the sensation entire and unimpaired, during the absence of the actual impression, in the admitted succession of illuminating particles.

Into this subject we shall not, upon the present occasion, enquire any further. I am, at this time, to make you acquainted with what has been recently done in *practical optics*, by two very ingenious artists: the one, Mr. Ramadge, a currier, residing at Aberdeen; the other, Mr. Cuthbert, a regular optician, residing in Lambeth. Many of you may remember that we had, some time since, an opportunity of witnessing the ability in constructing and describing instruments, which was displayed by Mr. Francis, once a shoemaker, although now entirely engaged in optical pursuits; and it is worthy of remark, in regard to the history of the achievements of Mr. Ramadge, that he was found by Dr. Olinthus Gregory, pursuing his original trade, at a time when he had so far succeeded in the construction of astronomical instruments, as to entitle him, in Dr. Gregory's opinion, to the character of one of the first artists in the kingdom Of this eminence, it is probable, that the greatest portion is due to the native bias and power of his genius; although it is possible that, being within the reach of the mechanical and scientific talents of my late excellent friend, Professor Copland, he may have benefitted not a little, by his kind and communicative disposition. Respecting this point, however, as well as many others, we shall, ere long, have an opportunity of satisfying ourselves, by having Mr. Ramadge amongst us; when I hope to have the pleasure of producing him in person, as, until a few hours since, I expected to have had the pleasure of producing the model of his very powerful *telescope*. It was indeed my intention, in exhibiting this model, to have directed your attention to the contrivances of a *mechanical nature*, rather than to have pointed out its strictly *optical merits*; but even this I cannot now accomplish, because I yesterday found, when my plans were all arranged, that, in consequence of the time of the Astronomical Society, at its first meeting, having been otherwise occupied, the model was not then presented; and, as it was sent hither expressly for their inspection, it appeared right that its first public appearance should take place before that distinguished scientific association. I must now only advert to the construction, in the diagram of another telescope, and occupy you a little more with the principles of the science, than I had previously designed. I shall even again advert to the subject of *light*, for the purpose of shewing you a very beautiful prismatic appearance, made known to me very conveniently for my purpose, by our excellent Chemical Lecturer, Mr. Cooper, and brought before you by its ingenious inventor, Mr. Woodward.

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[*] Vide note, Vol. I. p. 216

The object of this invention will be perceived, by attending to an effect which has been formerly made known to you, viz., the power of a *prism*, or three-sided piece of glass, to separate a ray of light into seven portions, or *prismatic colours*. We have not at present an opportunity of introducing rays of light from the sun itself, but we shall find that, by the combustion of *calcium*, or the metallic base of *lime*, we can produce an artificial sun, with an evolution of such light as the solar rays are composed of; and by directing this light through a prism, we shall be enabled to decompose it into the seven colour-making rays, of which light is constituted.

The Theatre was now completely darkened, to give effect to the beautiful experiment about to be exhibited, and Mr. Cooper stepped forward with Mr. Woodward, to adjust the apparatus alluded to by the worthy President. This instrument consists of an application of Mr. Gurney's *oxy-hydrogen blow-pipe* to the combustion of *lime*,* for the purpose of producing an intense evolution of light for optical experiments. As soon as the flame, arising from the ignition of the mixed *oxygen* and *hydrogen* gases, was directed upon the *lime* from the jet, its combustion was effected, and the light being directed through the prism attached to the apparatus, a splendid *artificial rainbow* appeared upon the cieling of the Theatre; exhibiting all the beauty of the natural bow, and displaying the prismatic colours in the same perfection.

Dr. Birkbeck requested the Members to observe, that one margin of the spectrum (that which exhibited the *red rays*) was extremely well defined, and that the remaining colours, *orange*, *yellow*, *green*, *blue*, *indigo*, and *violet*, appeared to melt gradually into each other; the opposite margin, consisting of the *violet rays*, being less distinctly defined, as in the natural rainbow. It is of some consequence to recollect this experiment, as the prismatic colours, intentionally exhibited upon this occasion, are, in all optical instruments, liable to intrude unintentionally upon the field of vision, causing the appearance of coloured images, and this effect, or rather defect, it has been found extremely difficult to obviate.

It has been observed in the most recent, but the least popular work on *optics*, the treatise by Mr. Coddington, of Cambridge, that "the science of optics reposes upon three laws, as they are technically termed, which depend, for their proof, upon experiment and induction." These laws are:—

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* In Mr. Lewthwaite's lecture, on the Oxy-hydrogen Blow-pipe, (Vol. II. page 130,) our readers will find an ample description of the construction of this important instrument, and its application to scientific purposes. The *combustion of lime* was one of the interesting experiments performed by that gentleman; and the vivid intensity of the light which it evolves, is particularly noticed in our report of the lecture.—ED.

1. The rays of light are straight lines.
2. The angles of incidence and reflection are in the same plane and equal.
3. The angles of incidence and refraction are in the same plane, and the sines bear an invariable ratio, for the same medium, to one another."

That the rays of light proceed in straight lines, was shewn by the conical shadow projected by a globular body, and also by the fact, that no art can direct the rays through a crooked tube, or cause a single particle of light to produce illumination behind an opaque substance. These simple facts, if they had been duly estimated by some celebrated opticians, would have sufficiently weakened, or have even totally destroyed the *undulatory* system of Euler; which has been recently revived by Dr. Young, and appears to be making some progress in this country.

The Lecturer illustrated the second law by a suitable diagram, shewing that the *incident* ray, or that which proceeds from a luminous body, to fall on a polished surface, at any angle from the perpendicular, is *reflected* at exactly the same angle beyond it. Another diagram shewed that the same law holds good with respect to plane mirrors or looking-glasses, and a third explained the reason why concave and convex mirrors reflect an image either greater or less than the object.

The third law, which relates to the *refraction* of light, was explained by a diagram, representing the bent appearance of a straight rod, when partly immersed in a bowl of water. In this case, the angle which the immersed end forms with the perpendicular, differs from that which is formed by the opposite extremity; but the sines of these two angles always bear an invariable ratio to each other, when the rays of light are refracted in the same medium. Now, this is an effect which is constantly taking place around us without our perceiving it; for, owing to the refraction of the rays both of the sun and moon during their passage through the atmosphere, we see them before they are actually above the horizon; and, as the rising of the sun is thus anticipated, and his setting, for the same reason, protracted, the days are proportionally prolonged. This effect of the refraction of the sun's rays is of vast importance to the inhabitants of those regions, which are situated in very high latitudes; and even in our own country, some strange effects have been witnessed, arising from the refractive power of the atmosphere, which varies according to its density. It is a well attested fact that, upon one occasion, the inhabitants of Hastings had a distinct view of the whole line of the French coast, which, under ordinary circumstances, is completely concealed from their sight, by the intervening convexity of the earth.

On these operations and these laws depends the effect of all optical instruments, from the first rude telescope of Zacharias Jansen, the spectacle-maker of Middleburg, to the magnificent telescope of Herschel. Dr. Birkbeck here exhibited models, representing the various form of *lenses* used for optical purposes, viz.:—the *plano-convex*, *plano-concave*, *double convex*, *double concave*, and the *concavo-convex* lens, or *meniscus*; and proceeded to observe that great diversity of opinion had prevailed as to whether Jansen, or Baptista Porta, or Galileo, was the first to put two such glasses together, so as to form a telescope. The first attempt was probably the result of accident; but it was design, and not accident, which led Galileo to effect the construction of telescopes, after it was reported to him that such instruments had been formed by Jansen.

To render the general construction of telescopes more intelligible, Dr. Birkbeck here directed the attention of the audience to diagrams, representing the five glasses above-mentioned, and also the manner in which the rays of light are made to converge by the *plano-convex* and *double convex* lenses *.

The subject was further illustrated by means of two globes of glass, one of which was filled with *alcohol*, and the other with *water*. A lamp being placed behind these globes, which acted as lenses, the image of the flame in an inverted form, was thrown upon a screen of dead glass, placed before the globes, and it was seen that the image appeared more or less distinct, according to the distance of the light and the globes from the screen, and also that the relative distances necessary to produce a distinct image differed according to the different densities of the two fluids with which the globes were filled, the refracting power of *alcohol* being greater than that of *water*.

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* The diagrams here alluded to, with a description of the manner in which the rays of light are refracted by the plano-convex and double convex lenses, will be found in our first Volume, page 213.

After these elementary remarks, the Doctor proceeded to describe the Galilean Telescope, in which a *double concave eye-glass* is combined with a *double convex object-glass*, upon which principle the common Opera-glasses are constructed. In instruments of this kind, which are called *refracting telescopes*,* the lens at the extremity of the tube, is called the *object-glass;* and the lens near the eye is called the *eye-glass.* But if there be more than two lenses, as in the improvement of De Reitz, all of them, except the *object-glass*, are called *eye-glasses.* The Lecturer here adverted to two refracting telescopes, on the Lecture table, constructed by Mr. Jones, and described the mechanical arrangement by which they were moved either vertically or laterally, and the manner in which the distances of the eye-glasses were changed according to circumstances. In the common astronomical telescope, three eye-glasses are employed in connection with the object-glass.

In consequence of the difficulty of constructing telescopes with a large aperture, so as to embrace an extensive field of view, without rendering the images indistinct by the prismatic colours, Mr. James Gregory, of Aberdeen, projected the *reflecting telescope* *, which was completed (for Gregory never constructed one,) by the celebrated Sir Isaac Newton. Dr. Birkbeck here described the construction of the reflecting telescope, by a reference to suitable diagrams, and proceeded to exhibit Mr. Cuthbert's telescope, which was remarkable as the *shortest* reflecting telescope ever invented, being three inches in diameter, and only seven inches and three-quarters in length;—the focal length of the reflector being five inches and a-half. In all former instances a *three inch aperture* had required that the telescope should be *eighteen inches long;* and whilst these instruments, although much larger, had magnified one hundred and fifty times, Mr. Cuthbert's extended the linear surface two hundred and fifty times.

Dr. Birkbeck then observed that, as he had thus exhibited the *shortest* reflecting telescope ever constructed, he would now direct the attention of his hearers to the *longest* optical instrument of this description that had hitherto been produced, viz., the grand telescope of Dr. Herschel. A large and beautiful transparent diagram of this magnificent instrument was here exhibited to the audience, and excited mingled feelings of surprise and approbation. Of this elegant transparency, the engraving, which forms the frontispiece to the present Number, is a correct representation, and we feel much satisfaction in embracing the present opportunity of laying it before our readers.

The view of this mighty instrument, as represented in the transparency, exhibits it in a meridional situation, as it appears to a spectator placed to the south-west of it. The foundation in the ground, consists of two concentric circular brick walls, the outermost of which is 42 feet in diameter, and the inside one 21 feet. They are 2 feet 6 inches deep under ground; 2 feet 3 inches broad at the bottom, and 1 foot 2 inches at the top, and are capped with paving stones, about 3 inches thick, and 12¼ broad. The bottom frame of the whole apparatus rests upon these two walls, by 20 concentric rollers I I I, and is moveable upon a pivot, which gives a horizontal motion to the whole apparatus, as well as to the telescope.

The tube of the telescope A, is formed of *sheet-iron*, of the weight of about 14lbs. to the square foot. Its length is 39 feet 8 inches, and its diameter 4 feet 10 inches. Of the immense weight of the whole of this splendid apparatus some idea may be formed, when it is stated that Dr. Herschel saved 3000lbs. in the weight of the tube alone, by constructing it of sheet-iron. The great reflecting mirror is about 49 inches in diameter, and 3½ inches thick, and weighs 2118lbs. Considerable skill is displayed in the contrivance of the apparatus, by which this vast tube is supported and directed. In order to command every altitude, the point of support is moveable, and its motion is effected by mechanical arrangements, so that the telescope may be moved from its most backward point of support to the most forward; and by means of the pulleys G G, suspended from the great beam H, be set to any altitude, up to the very zenith. The tube is also made to rest with the point of support in a pivot, which permits it to be turned horizontally.

To make observations by this mighty instrument, the observer is placed in a seat C, situated at the upper extremity of it, with his back towards the object whose image he views; so that the observer and the object may be said to be looking into the same end of the telescope. Sir William Herschel used only a single eye-glass, for he considered two eye-glasses as a luxury too great for a philosopher to indulge in; but what the nature of this extraordinary luxury really was, the Lecturer acknowledged himself unable to discover.

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* Our readers will find a description of the construction of *refracting* and *reflecting* telescopes, with illustrative diagrams, in our first Volume, pages 247, 248.

From the opening of the telescope, near the place of the eye-glass, a speaking-pipe runs down to the bottom of the tube, where it goes into a turning-joint, and after several other inflections, it at length divides into two branches, which communicate with the two buildings, between which the telescope is suspended. One of these branches enters the *observatory* D, and the other goes into the workshop E. By means of this speaking tube, the communications of the observer are conveyed to the assistant in the observatory, and the workman is directed to perform the required motions.* Herschel's telescope magnifies 6000 times; but great as its merits undoubtedly are, the construction of Mr. Cuthbert's reflecting telescope, which magnifies 250 times, with so short a tube, is decidedly superior.

Dr. Birkbeck now adverted to Mr. Ramadge's telescope, the model of which he had hoped to be enabled to exhibit this evening. The tube of this instrument is 26 feet in length, but the circumstance to which he particularly wished to direct the attention of the Members, was the great superiority of the mechanical arrangements by which its motions are governed. This improvement consists in applying the power of the *pulley* by means of a combination which, upon a former occasion, he had observed was not so generally adopted as it ought be. In this modification of the pulley, the cords pass round a cylinder, of two different *diameters;* and Mr. Ramadge, taking advantage of this plan, has placed a cylinder of this description at the top of his tube, the handle being within his reach, by which means he is enabled to vary the altitude of the tube with great facility, or to change its position laterally, as the object escapes from the field of view. This is one of the very few instances, in which this very useful contrivance has been advantageously employed.

The President concluded his able illustrations of the Telescope, by remarking that the vast power of Herschel's instrument was attended with considerable disadvantages in its practical application. When it is directed to the Sun, the object-glass is frequently shivered to pieces by the intense focal heat reflected from the large mirror; and in the neighbourhood of London, the impurities which float in the atmosphere, being magnified 6000 times, and placed between the observer and the object, present impediments to distinct vision, which are often insurmountable.

On the subject of *microscopes*, the Doctor observed that, according to their usual construction, the eye is distressed by looking downwards through a small eye-glass, but this inconvenience is obviated by applying the principle of the Newtonian, or *reflecting telescope*, to the formation of *microscopes*. Mr Cuthbert has succeeded in producing a *reflecting* microscope, so extremely powerful, and capable of concentrating so large a portion of light, that a single particle of the down of a butterfly's wing may be subjected to a more minute examination than was ever before accomplished. A diagram, exhibiting one of these minute particles magnified to about four inches in length, was here referred to by the Lecturer, who pointed out a distinct peduncle at the bottom of the fan-like atom, from which a number of lines proceeded towards its edges. There can be no doubt that these lines are actual vessels for conveying a fluid which affords a nourishment to every particle of down. How infinitely minute, then, must be the vascular structure of these atoms, the nature of which, but for Mr. Cuthbert's powerful microscope, might have remained unexplored.

The Theatre was again darkened, for the purpose of shewing the operation of the *solar microscope*, by means of the ingenious application of the *oxy-hydrogen blow-pipe*, described in the early part of the Lecture. The images of the objects, powerfully illuminated, were thrown upon a screen placed before the apparatus, and the magnitude to which they were enlarged, enabled the spectators to distinguish their most minute parts in the greatest perfection. Specimens of different kinds of wood, such as beech, willow, &c. both branches and roots, were thus exhibited, and the variety observable in the beautiful structure of their fibres, was admirably exemplified. This application of the oxy-hydrogen blow-pipe is a striking instance of the power of science, for when the combustion of the mixed gases was first employed for the purpose of producing an intense heat, the apparatus could not be used without endangering the life of the operator, though in its improved form, it may be directed to scientific purposes with perfect safety; and for optical experiments, we can produce *a sun of our own*, without waiting for the solar rays, or undergoing the inconvenience occasioned by the lamp connected with the common *lucernal*.

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* The description of this immense telescope, and the machinery attached to it, viz., the stairs, ladders, and platform B, occupies 63 pages of letter-press, in the Second Part of the Transactions of the Royal Society for 1795, and is illustrated by 18 plates; explaining every circumstance relating to joiners, carpenters, and smiths' work, which attended the formation and erection of this noble instrument. It was completed on the 28th of August, 1789, and on the same day, the sixth satellite of Saturn was discovered.

Dr. Birkbeck concluded his excellent and instructive Lecture by observing, that the information derived from the *Telescope* and the *Microscope*, two invaluable efforts of human invention, has been displayed in contrast, with all the fidelity of the philosopher, and all the glowing enthusiasm of the enlightened observer of the wonders of nature, by the celebrated Dr. Chalmers, in the following quotation from one of his splendid discourses.

"About the time of the invention of the *telescope*," says he, "another instrument was formed, which laid open a scene no less wonderful; and rewarded the inquisitive spirit of man, with discoveries no less important. This was the *microscope*. The one led me to see *a system in every star*: the other leads me to see *a world in every atom*. The one taught me that this mighty globe, with the whole burthen of its people and of its countries, is but a grain of sand on the high field of immensity. The other teaches me that every grain of sand may harbour within it, the tribes and the families of a busy population. The one told me of the insignificance of the world I tread upon: the other redeems it from all its insignificance; for it tells me that in the leaves of every forest, and in the flowers of every garden, and in the waters of every rivulet, there are worlds teeming with life, and numberless as are the glories of the firmament. The one has suggested to me, that beyond and above all that is visible to man, there may he fields of creation, which sweep immeasurably along, and carry the impres- of the ALMIGHTY's hand to the remotest scenes of the Universe: the other suggests to me, that within and beneath all that minuteness, which the aided eye of man has been able to explore, there may be a region of invisibles; and that could we draw aside the mysterious curtain which shrouds it from our senses, we might there see a theatre of as many wonders, as Astronomy has unfolded;—a Universe, within the compass of a point so small, as to elude all the powers of the microscope;—but where the wonder-working GOD finds room for the exercise of all his attributes; where he can raise another mechanism of worlds, and fill and animate them all with the evidences of his glory!"

MR. COOPER'S
EIGHTH LECTURE ON CHEMISTRY.

ANALYSIS OF AMMONIACAL GAS—SALTS OF AMMONIA—CARBONATE, SULPHATE, AND NITRATE OF AMMONIA—DECOMPOSITION OF AMMONIACAL SALTS—GASEOUS AMMONIA DECOMPOSED BY ELECTRICITY—BY A HEATED IRON TUBE—BY THE AGENCY OF CHLORINE—BY OXYGEN—AMMONIA GENERATED BY THE ACTION OF ZINC, &c ON POTASH—BY OPERATING WITH NITRIC ACID ON TIN, &c.

FRIDAY, NOVEMBER 18TH.

MR. COOPER this evening continued his remarks on the substance which formed the subject of his previous Lecture, and observed that he had little to add to his former observations, except what related to the analysis of the gas itself, *ammonia*. He would, however, in the first place, say a few words relative to the *salts of ammonia*, and their decomposition. He had already shewn that *salts* were formed by the combination of *ammonia* with different *acids*, but he had not yet specifically pointed out the *alkaline* properties of this substance. It has been frequently seen that vegetable colours of a certain class are more or less affected by *acids* and *alkalis*, particularly vegetable *blues* and *yellows*; the former of which is changed to *red* by an *acid*, and the latter to *brown* by an *alkali*. It will be found that upon immersing a piece of paper, previously tinged with a yellow colour by an infusion of *turmeric*, into *ammonia*, either in the form of gas, or in a state of solution, the *alkaline* properties of the latter substance will be at once demonstrated, by the colour of the turmeric paper being changed from *yellow* to *brown*.

Mr. Cooper here removed a jar of *ammoniacal* gas, from the mercurial trough to the Lecture table, and exemplified his remarks by introducing a slip of turmeric paper into the gas, which instantly changed its colour to brown, but he observed that the paper resumes its yellow tint almost immediately upon being brought in contact with the atmosphere, for the *ammonia* is of so extremely *volatile* a nature, that it evaporates in a few seconds, and leaves the paper of the same yellow colour as before its immersion. A variety of other vegetable substances experience an analogous change in their colours by the action of this and of all the other *alkalis*. Brazil-wood, and Log-wood, in solution, are both changed to a purple colour, by *ammonia*, and thus become satisfactory tests for discovering its presence.

In the course of the last Lecture, some *salts of ammonia* were formed by the combination of *ammonia* with the *muriatic* and *carbonic acid gases;* and it was found, upon applying the blue litmus paper to the *muriate of ammonia*, formed by the union of *muriatic acid* with *ammonia*, that its colour was reddened by the small quantity of acid which was in excess; but upon the addition of a little ammonia, the blue colour of the paper was restored. It therefore appears, that acids and alkalis, in some instances, combine, so as to form a class of salts which are perfectly *neutral*, while in other cases, either the *acid* or the *alkali*, is in excess. But whether the union of an *acid* with an *alkali*, an *earth*, or a *metallic oxide*, is found to exhibit *acid*, *alkaline*, or *neutral properties*, the resulting compound is invariably called a *salt*.

Mr. Cooper then produced the glass vessels in which he had, during the previous Lecture, formed the salt called *carbonate of ammonia*, by the union of *carbonic acid gas*, with *gaseous ammonia*, in different proportions. One of these products was formed by uniting the constituents in equal volumes, and the other by combining two volumes of carbonic acid with one of ammonia. The Lecturer here formed solutions of each of these salts, and upon dipping a piece of turmeric paper into the former solution, its change of colour proved that it possessed decidedly *alkaline* properties, the *acid* not having been added in sufficient quantity to saturate the whole of the *ammonia*. When, on the contrary, the tests were applied to the latter solution, in which the *carbonate* had been formed by uniting two volumes of *carbonic acid gas*, to one of *ammonia*, its neutral character was distinctly demonstrated; for it neither changed litmus paper red, nor turmeric paper brown, and it was therefore evident, that it possessed neither *acid*, nor *alkaline* properties.

Other salts of ammonia are formed by the union of *sulphuric* or *nitric acid* with *ammonia*. The qualities of these salts, which are called respectively the *sulphate* and *nitrate of ammonia*, have been already described; and the latter has been employed in the production of *nitrous oxide*. The carbonate of ammonia is identical with the substance contained in the bottle now exhibited, the liquid carbonate having been allowed to cool gradually; after which, the crystals deposited, were separated and kept for use.

Ammonia, in a pure form, is elicited when any of its salts are acted upon by *alkalis* or *alkaline earths*, such as potash, soda, lime, barytes, strontian, &c. in a caustic state. The common process of decomposing ammoniacal salts, has been shewn by the action of *lime* on the *muriate of ammonia*, and the same effect would have occurred if *soda* had been employed. But if, instead of using these alkalis, &c., we operate with their *carbonates*, double decomposition ensues; the *carbonic acid* of the *carbonate* being transferred to the *ammonia*, while the *acid* of the *salt* passes over to the *alkaline base* of the *carbonate*. Let us take, for example, the *muriate of ammonia*; if we operate upon it with *lime*, what effect takes place?—an instance of single decomposition evidently occurs; the *lime* uniting with the *muriatic acid*, while the *ammonia* is liberated. But if, on the contrary, we use *carbonate of lime*, or *lime* in combination with *carbonic acid*, the *muriatic acid* still seizes the *lime* as before, but at the same instant, the *carbonic acid* goes over to the *ammonia*, and forms *carbonate of ammonia*.

If a portion of ammonia, in a gaseous state, be subjected to the action of electricity, by passing a series of shocks through it, and continuing the operation for the space of a quarter of an hour, or more, it will be found that the bulk of the gas will become greatly increased. Mr. Cooper here produced a tube, formed like a syphon, in the upper part or bend of which, a small quantity of *ammonia* was confined by mercury. This apparatus was placed in communication with the electrical machine, and the spark was passed through the gas for some time, by which its bulk became sensibly enlarged; and the Lecturer observed, that if the experiment were continued for about an hour, it would expand into exactly double its volume. The reason of this is obvious; for the *ammoniacal gas* is decomposed by electricity into its original elements, and as it has been shewn by the diagram, that these elements consist of one volume of *azote* to three of *hydrogen*, which *four volumes* are condensed into two by their union, it is evident that the two volumes of which ammonia is formed, must be expanded into four by its decomposition.

The same effect takes place when *ammonia* is passed through a red hot tube. To perform this experiment, the Lecturer inverted in the mercurial trough, two glass vessels, one of which contained a given quantity of *ammoniacal gas*, while the other remained full of quicksilver. In the front of the trough stood a small furnace, through which passed a bent tube, the two extremities of which, were placed in communication with the two vessels; and the object of the experiment was to make the *gaseous ammonia* pass from one vessel to the other through this tube, and to decompose it during its passage through the heated part, by bringing it in contact with the ignited surface of the tube. Mr. Cooper passed the gas backwards and forwards several times, by pressing down the two vessels alternately; but a full red heat was necessary to effect its decomposition; and, as the furnace had not yet sufficiently heated the tube, he allowed the apparatus to remain for some time, while he proceeded to point out another method of separating *ammonia* into its constituent elements.

This method consists in subjecting *ammoniacal gas*, or its solution in water, to the action of *chlorine*. When *ammonia* and *chlorine* are mixed together, decomposition immediately ensues; the *chlorine* uniting with the *hydrogen* of the gas to form muriatic acid, while its *azote* is set at liberty. The Lecturer here produced two vessels, the one containing *chlorine*, and the other, an *agueous solution of ammonia*. The moment these substances were mixed, an intense chemical action took place, and a considerable quantity of dense vapour was evolved; this effect is frequently so great, that, at the instant when the liquid ammonia is poured into the chlorine, a flash of light fills the vessel. Great heat is also given out during the combination; but the vapour in a short time subsides, and is absorbed by the water introduced into the vessel, when it is found that the *chlorine* has disappeared, and its place is supplied by a quantity of *azote*.

Gaseous ammonia and *chlorine* may be united in a manner analogous to the experiment in which the former has been placed in contact with *muriatic acid gas*, and its decomposition similarly effected. This may be best accomplished by exhausting a vessel of atmospheric air, and introducing about half its bulk of *chlorine*. The Lecturer observed, that he had once performed this experiment, but the gases united with dangerous violence, while the interior of the vessel was filled with a brilliant white flame; and if the stopper of the bottle had not been loose, he should in all probability have sustained a serious injury. On this account, he did not wish to run the risk of injuring his auditors or himself, by a repetition of the experiment in a similar manner. It might, however, be performed with tolerable safety, by holding the two vessels loosely in the hands, and placing their mouths in contact with each other. Mr Cooper accordingly united the two gases, by this method, but the effect was, even then, sufficiently violent; for the vessels were forced asunder with a hissing noise, a volume of dense white vapour rushed from between them, and the Lecturer remarked, that if the theatre had been darkened, a flash of light would have been seen at the same moment.

But the constituents of ammonia may also be ascertained, by subjecting a known quantity of the gas to the action of *oxygen*, and passing the electric spark through the mixture; but some precaution is necessary in performing this experiment, in consequence of the strong affinity of *oxygen* for *hydrogen* at a high temperature. It is therefore necessary, in the first instance, to operate with only half the quantity of *oxygen* necessary to saturate the whole of the *ammonia employed*. Mr. Cooper here introduced five measures of *gaseous ammonia* into a cylindrical vessel, standing over quicksilver; and having passed up 2¼ measures of *oxygen*, he exploded the mixture by the electric spark, when the volume of the gas became instantly diminished. He then admitted another portion of *oxygen*, sufficient to neutralize the remainder of the *ammonia*, and repeating the electric shock a further diminution of volume took place and the mercury rose higher in the vessel.

As the *oxygen* has now united with the whole of the *hydrogen* of the *ammonia*, it follows, that nothing but *azote* remains, and if a sufficient quantity of the gas had been employed, it would have been further demonstrated, that its constituents unite in the proportion of one volume of *azote*, and three of *hydrogen*.

Dr. Henry, who has devoted more attention than any other chemist, to the analysis of *ammonia*, by electricity, has found, that if this gas be mixed with *nitrous gas*, or *nitrous oxide*, the gases are decomposed by the electric spark. If 10 parts of *ammonia* be exploded with 13 parts of *nitrous oxyde*, the *azote* of both is set at liberty; and by operating with 100 parts of *ammonia*, mixed with 120 parts of *nitrous gas*, the quantity of *oxygen* in the latter, is sufficient to combine with the whole of the *hydrogen* of the former, and leave nothing but *azote* remaining.

Mr. Cooper examined the progress of the experiment for decomposing ammonia, by passing it through a heated tube, but observed, that he feared the tube was not sufficiently heated to render the effect of the operation evident. The furnace was a new one, which had not been previously tried, and its draught was not strong enough for the purpose. In his next Lecture, he would, however, repeat the experiment, he hoped, successfully; for he was the more particular on this subject, because, this was the last lecture he should deliver on the nature and properties of *gaseous bodies*. His next discourse would be directed to an illustration of the *atomic theory*, or the doctrine of *chemical proportions*. The Institution was in possession of a very extensive scale of *chemical equivalents*, the construction of which he should endeavour to explain.

The Lecturer proceeded to observe, that it had been lately discovered by his friend, Mr. Faraday, that when *potash* is acted upon by some of the metals, particularly *zinc*, a portion of *ammonia*, is always generated. To what cause this effect is attributable, whether to the accidental contamination of *animal matter*, or to any other unobserved circumstance, is not at present ascertained, but it deserves to be noticed as a curious fact. Mr. Faraday used the utmost precaution to insure the purity both of the *alkali* and the *zinc*; he employed *potash* recently prepared from *potassium*, and took care not to touch it with his hands during the operation, and he made use of *zinc* which had been lately distilled. It was therefore to be presumed that no *animal matter* could be present, yet *ammonia* was always found.

Mr. Cooper exemplified this fact by means of a tube containing a portion of *potash*, on the surface of which some *zinc* was placed. Upon applying heat to the tube, the *potash* was fused, and, at a higher temperature, the *zinc* was also fused, and sunk to the bottom of the tube. The quantity of *ammonia* evolved in this experiment was necessarily very small, but that this gas was present, was rendered evident by immersing a piece of turmeric paper in the atmosphere contained in the vessel, when the paper immediately assumed a brown tinge. The Lecturer did not attempt, nor did Mr. Faraday, to account for the formation of *ammonia* under these circumstances, but such was the fact.

Ammonia is also generated by the action of tolerably strong *nitric acid* upon *tin*. Mr. Cooper here poured some *nitric acid* on a small quantity of *tin*, when an intense chemical action ensued, accompanied by a copious evolution of *nitrous gas*, which escaped in red fumes. The tin was now oxidizing, by combining with part of the *oxygen* of the *nitric acid*, and in a short time was converted into a white powder, which was destitute of metallic properties. But in this experiment we have the elements of *ammonia* present, for the *water*, and also the *nitric acid* which it holds in solution becomes decomposed; and the *hydrogen* of the water, coming in contact with the nascent *nitrogen* of the nitric acid, combines with it to form *ammonia*. To render its presence evident, it is necessary to use an *alkali* with the *calx*, or *oxide of tin*, for which purpose a solution of *potash* is employed. This was accordingly done, and upon introducing a slip of *turmeric* paper into the vessel, its colour was instantly changed to brown; thus evincing the formation of *ammonia* during the decomposition of *nitric acid* by *tin*.

Mr. Cooper here observed, that after exhibiting these various methods of decomposing *ammonia*, he thought it unnecessary to occupy the time of his hearers by shewing its decomposition by *nitrous oxide*, or *nitrous gas*, to which he had briefly adverted, and he therefore concluded by repeating, that in his next Lecture, he should treat of the subject of *chemical equivalents*.

IMPORTANT NOTICE, RELATIVE TO THE SECOND ANNIVERSARY DINNER, ON FRIDAY NEXT.

Dr. Birkbeck then stepped forward, and observed, that he was sure it would afford the Members great satisfaction to hear that His Royal Highness the Duke of Sussex had, in the most kind and condescending manner, expressed his intention to take the Chair, at the Second Anniversary Dinner of the Members and Patrons of the Institution. When the Members recollected the great interest which that illustrious individual had uniformly taken in the prosperity of the Institution; and when they also remembered the advantages which has accrued to every establishment, which had enjoyed his patronage and assistance, they could not fail to regard His Royal Highness's presence, upon that interesting occasion, as a most propitious circumstance. Dr. Birkbeck added, that he was requested to state that Tickets for the Dinner, 6s. 6*d.* each, might be had of the Secretary, or of any Member of the Committee, till Monday, the 28th instant, by which day it was necessary to ascertain the number of persons likely to attend on the following Friday, in order that suitable arrangements might be made, for the accommodation of every individual who was disposed to be present.

EFFECTS OF CARBONIC ACID GAS ON THE ATMOSPHERE.

To the Editor of the Mechanics' Register.

Sir,—Hudibras somewhere speaks about men resolved

"—— as if in spite,
"Of reason and their stars to write."

This was most forcibly brought to my mind on reading the letter of Gmo. Henricus, in your last Register. Permit me to say a few words to him on the very valuable "*new and important views*" therein truly specified.

It appears he is not satisfied with the properties and habits of carbonic acid gas as described in your pages; and in giving his own opinion freely of the opinions of others, he justifies them in answering him in the same style of freedom.

I shall, by your leave, do so; dissecting his letter throughout; and if I do not shew it to be a tissue of nonsense, write me down ass for ever.

He says in the first place, "In the different arguments that have been used," &c. There have not been different arguments on the subject: the different arguments have been about "What air or gas do vegetables generate?" (See Vol. I. page 143,) and not "if plants absorb, &c." since I am vastly mistaken if any one but myself has written a word on the subject.

He says "it has been taken for granted, because no animal can respire carbonic acid gas unmixed, &c. that therefore in whatever proportion it is developed in the atmosphere, in the same degree it must be deleterious:" now not an observation has been made to justify him in saying so; on the contrary, I, the only writer on the subject, take leave to instance the quantity formed in respiration, which is, as every breathing assures us, perfectly harmless.

He speaks of Providence, in connexion with the absorption of carbonic acid gas by vegetables, in a way sounding to me somewhat unbecoming. But that such an absorption does take place, is well known to every scientific man living. And as I have before stated, so I repeat here: nature instructs us in no other mode she has of getting rid of such vast quantities of this gas, than by its decomposition in vegetables. It is their support; (that is, its carbon) and they breathe as it were and absorb it, as necessary to their existence, as we do oxygen. Here it must be observed, by the bye, that it is not on all hands agreed that oxygen enters into our circulation, most persons supposing it merely combines with the carbon of the blood, forming carbonic acid gas. But if I may be allowed an opinion, as being formerly in the medical profession, I should say a part of it does enter the system.

He says, "carbonic acid gas preserves mineral compositions:" Will he tell us how? And what those compositions are requiring such preservation.

He says, "oxygen gas is not to be respired unmixed for any length of time,

&c." and lower down he says "it is not to be respired at all;" oxygen gas I answer, may be respired unmixed, and *long* without injury; its effects being deleterious when breathed pure, only as nourishment or stimuli taken in excess: and it is moreover declared, that breathing this gas pure has cured many dis-

He says, "It is for some wise purpose carbonic acid gas is superadded to atmospheric air;" nobody doubts it. If it enters, as G. H. says, into all animal and vegetable substances, forming a great part of their bulk, of course it is not astonishing it is found in the air, which is so fit a vehicle for conveying it to them; but it is certainly not found there as necessary to healthy respiration, as he implies.

He says, "it may be considered a bold thing, Mr. Editor, &c. to assert that the air is more frequently deteriorated by excess of oxygen than by fixed air!"*

Ay, bold indeed; but we must forgive his boldness, for the merriment he causes, and the laughter he excites, first by his excessive vanity, and next by his telling us in the same sentence in which he displays it, that were it not for lime and brick kilns, found in cities, they would scarce be habitable!!! Ah, you naughty officers that took up men the other night, and called them vagabonds (See the Times paper) because they dared to sleep near a lime kiln: could you not, dull of apprehension, perceive these were but poor philosophers offering up their adoration at the shrine of their favourite; the god of their idolatry; the philosopher's stone! the prolonger of life! the *renovator of cities!* without whose *vital breath* we could not exist!

And, vile sacrilegious wretches, how dared ye remove, a few days prior, another of these self-devoted philosophers, from the temple that he loved! true he was dead to us, in a worldly sense; but, like other possessors of the secret of the philosopher's stone, he was immortal in reality! never dying! lying in his glory, mixing his carbon with that from off or out of the altar, and wandering to renovate towns, cities, and the world at large!

As stated above, he says, "oxygen gas cannot be respired pure:" but I say it can be respired pure; and an animal confined in pure oxygen, as every body knows, or ought to know, lives three or four times as long as it would do in the same bulk of atmospheric air; certainly it remains in a high state of excitement to the last; but then it dies, not from exhaustion of body, but from the exhaustion of the gas in which it was confined.

He talks of "oxygen" (to produce the excess he names) "generated in close places." If I did not consider this matter as already set at rest by what I have before adduced, I should ask him where such places are to be found?

He speaks of the products of *fermentation*. I do not profess very correctly to remember the theory of fermentation but I know that carbonic acid is generated; I know that acetous acid is generated; and I am also confident that *sour* wine was never yet cured by carbonic *acid:* but I know it has by adding carbonate of soda. The soda entering into combination with the superabundant acetous acid, and *evolving* the carbonic acid gas with which it was previously combined.

In his last paragraph, he comes to this well attested and ably borne out conclusion; that "*oxygen gas is most destructive in its effects, and carbonic acid gas is its corrective!*"

"A Daniel, yea, a Daniel!
"O wise young judge, how do I honor thee!"

In this last paragraph he dwells upon his "important and new view;" and its fully answering the original query; and so, very complacently, takes his leave. Now pleasant dreams to him by night, and fanciful reveries by day; but before he again presumes to place his name amongst such worthies as your columns boast, let me, in sober sadness, advise him to read a little your own pages offer him plenty of food for reflection. He may eat till he fills, and come again, and eat, and come again. And strongly advising him to do so,

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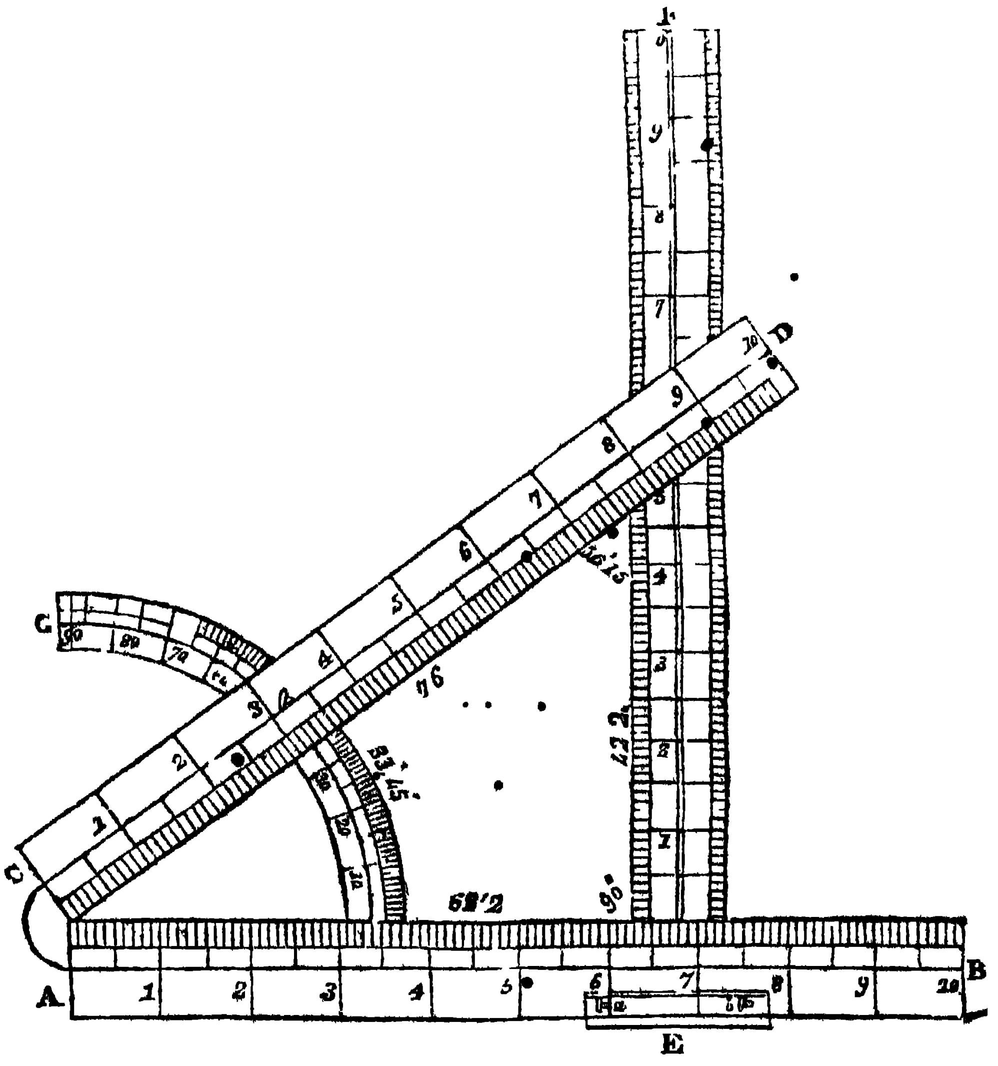
* Sir Humphry Davy examined the air of Bristol, and found it give about 21 per Cent. of oxygen.—Dr. Beddoes examined the air of the coast of Guinea. It gave the same.—Berthollet examined that of Egypt and France.—And Thomson, (see his Chemistry), that of London and Edinburgh, and they all gave the same result, and this independent of the state of the atmosphere. And it holds at all times and at all heights. Gay-Lussac brought air from more than 21,000 feet above Paris, and found it precisely as at the Earth's surface.—Is this enough for him?

I remain, Sir,
His and your very obedient servant,
F. C.

INSTRUMENT FOR MEASURING THE ANGLES AND SIDES OF RIGHT ANGLED TRIANGLES.

To the Editor of the Mechanics' Register.

SIR,—Some years ago an idea suggested itself to me, of an instrument to measure the angles and sides of right angled-triangles in Trigonometry, which I found to be so simple that I considered something of the kind was certainly to be met with;—but being a poor man, and not able to go to the expense, I thought no more about it, until recently seeing several plans of something similar, though in my opinion much too complicated for a young beginner in Navigation, &c. I take the liberty of offering mine, if you think it worth accepting, to the consideration of some of your learned Correspondents its construction needs little explanation.



The legs A B and C D are each made of two pieces firmly rivetted at each end, with a space left between each to admit the leg E F to slide freely backwards and forwards. G is a graduated arch, which need not exceed 50 or 60 degrees, firmly fixed in the leg A B, but traversing through the leg C D. E is a piece of brass made to slide on the lower edge of the leg A B, and through which the leg E F is rivetted; *a* and *b* are two screws which slide along a groove in the leg AB with EF, and which keep it in a perpendicular direction, as well as fix it when at the intended distance. There is a similar screw in C D, to fix it to the graduated arch.—The instrument never need be opened wider than 45 degrees; should a larger angle be given, by taking the complement, and inversing the sides, any course, distance, difference of latitude, and departure, may be measured.

I remain, Sir,
With respect, yours,
T. H* * * H.

PROPOSED IMPROVEMENT IN THE CONSTRUCTION OF SHIPS' BOATS.

To the Editor of the Mechanics' Register.

Sir,—When we consider the calamitous shipwrecks that have recently taken place, and their frequent occurrence, especially at this season of the year, any practicable plan for preventing the loss of life which generally attends such misfortunes, cannot fail to be acceptable. It very often happens that when a boat is lowered from a vessel in a gale of wind, it is filled and sunk immediately. Now, Sir, I would suggest, as a means of preserving the lives of my fellow creatures under such circumstances, whether it would not be advisable to build all Ships' Boats on the principle of *Life Boats*, as these vessels have been found so valuable in saving the lives of many individuals who must otherwise have perished. Perhaps some persons may state as an objection, that life boats are more expensive in their construction; to which I will answer, that if they succeed in saving the life of one sailor, (and whose life is more valuable than that of the man who defends his country during war, and enriches it in the time of peace?) the ship-owner ought to consider himself amply repaid. The old adage that "no one knows where the shoe pinches so well as the wearer," may be well applied to the men who pass their lives on the tempestuous ocean, while we are enjoying in security the fruits of their labour at home. Should you think these remarks worth your attention, I shall feel obliged by their insertion in your valuable work; and remain,

Your obedient servant,
H. W. Dewhurst.

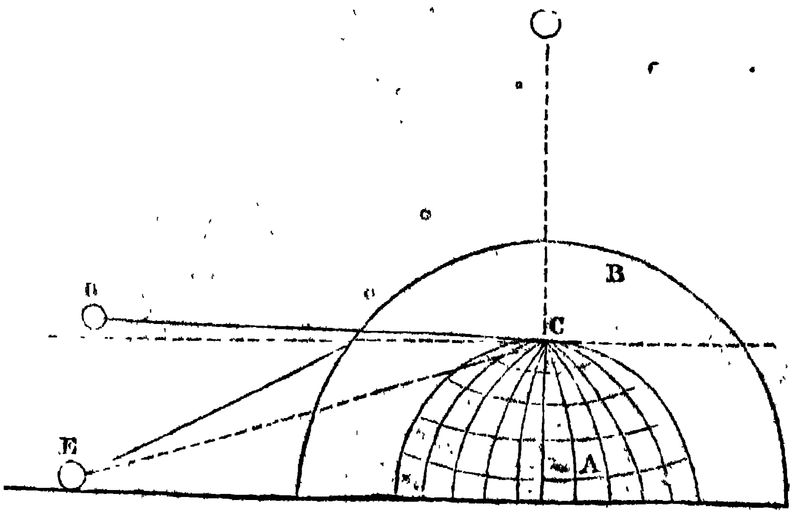
26, Prince's Road,
Kennington Cross.

QUERIES.

No. 12.

ASTRONOMICAL INQUIRIES.

Sir,—I should feel much obliged if any of your scientific friends could inform me, why the Sun appears so much greater just after it rises, and just befor it sets, than it does when at or near th meridian; and the same with the M I have thought, perhaps, the following might be the reason.



Suppose the inner circle A to represent the earth, the space within the outer circle B, to be the atmosphere that surrounds it, and the observer to be placed at the point C. Now if the atmosphere is capable (as I understand it is,) of refracting, or bending the rays of the sun, so that it shall appear to the observer, to be just above the horizon at D, when in fact it is below it at E, as will be seen by the dotted lines; if such be the case, I see no reason why the atmosphere should not be capable of *magnifying* as well as *refracting;* and we know that the rays of the sun must pass through a much greater portion of the atmosphere, when near the horizon, than when in or near the meridian. If I am wrong, I shall be thankful to be set right.

I shall be glad also, to see a plain account given of what is called a *shooting star,* which we often see on a clear night dart so rapidly across the Heavens.

Your constant reader,
W. W.

No. 13.

ANATOMICAL LEAVES AND PLANTS.

Of all the methods of preserving leaves and Plants for the Collector, none is more ingenious or beautiful than the above, and it would be rendering a great favour to your Readers generally, if any of your Contributors would point out the mode by which it is done.

These specimens are sometimes arranged in bouquets, at other times elegantly framed and glazed, and numbered, accompanied by a catalogue of their vulgar and botanical names.

The persons who sell them say, that the membranous part of the leaves is dissected with a very fine instrument, which leaves nothing but the veins and arteries of the Plant. But that I deem next to impossible, as many of the veins are as small as the thread of a cobweb, and tesselated, so as to resemble the finest tissue or Brussels lace.

If I were to hazard a conjecture, I should say, it was done by long immersion in water, or some other fluid, or else by being suspended for some period in a draught of air, and frequently wetted; the evaporation destroying the fine membranous part of the leaf.

Gмо. Hенrіcus.

No. 14

Sir,—I should feel obliged if any of your Correspondents could inform me of the best Varnish for Violins, and also the Size Coat, if any is required, previous to putting on the Varnish; and the method of using both.

I am, Sir,
Yours, &c.
G. B.

Kentish Town.

ANSWERS TO QUERIES.

Query, No. 104. Vol. II. Page 382.

COMBUSTION WITHOUT OXYGEN, OR IN A VACUUM.

Sir,—Observing in your Register, (p. 382,) an enquiry respecting combustion, I beg to trouble you with a few remarks, in answer thereto.

The enquiry contains two distinct questions.—1. "Can combustion take place without the presence of oxygen?" —2. "Can combustion take place in a vacuum?"

The first of these questions has been correctly answered by your Correspondent, "Luther," who states that certain metallic filings will burn in chlorine gas, and that phosphorus will inflame in the vapour of iodine.

With respect to the second question, I will state a few facts, the inference from which will, I think, materially differ from the answer in the concluding paragraph of the above-named Correspondent's communication: they will, at the same time, serve to shew why many of our most eminent chemists have now abandoned the appellations of "supporters of combustion," &c.

1. Many substances will combine and produce the phenomena of combustion, viz., "*light* and *heat,*" without the presence of any of those substances, which were denominated supporters of combustion; as *potassium* or *charcoal,* in *sulphuretted hydrogen.*

2. Supporters will combine with each other, as in the *protoxide of chlorine;* or even with an incombustible, as in the *chloride* and *iodide of azote;* all, on decomposition, evolving light and heat.

3. Combustion may take place, not only without the presence of any supporter, but *without the presence of any gaseous substance whatever;* as in the union of *sulphur* with certain

metals, and of *potassium* with *arsenic* or *tellurium*.

The last proposition will I think, Sir, fully satisfy your enquiring Correspondent, as to the possibility of producing combustion in a vacuum; however, to render this communication more extensively useful, I will, with your permission, annex Dr. Ure's inferences on this subject.

From other facts, in connexion with those I have stated, he infers—1st. "That combustion is not necessarily dependant on the presence of *oxygen*."—2dly "That the evolution of heat is not to be ascribed simply to gas parting with its latent store of that ethereal fluid, on its fixation or combustion."—And, 3dly. "That no peculiar substance, or form of matter, is necessary for producing the effect, but that it is a general result of the actions of any substances, possessed of *strong chemical attractions*, or *different electrical relations*; and that it takes place in all cases, in which an intense and violent motion can be conceived to be communicated to the corpuscles of bodies."

Your's respectfully,

S. P.

QUERY, No 6, Vol II Page 14

ETCHING ON STEEL PLATES.

SIR,—The following process has been laid before the public, by one of your contemporaries, but, as your correspondent, REPRAH, has made inquiry respecting the progress of etching on steel plates, I hope the subjoined description will be acceptable.

Your's, sincerely,

J. H B.

Leadenhall-street.

"Mr. Tyrrell's menstruum for etching on steel, is composed of four parts of the strongest *pyroligneous* or *acetic acid*, and one part of highly rectified *spirits of wine*, which are mixed together by gentle agitation for half a minute, one part of pure *nitric acid* is then to be added, and, when thoroughly mixed, it is ready to be poured on the plate. With these proportions, very light tints are obtained in a minute, deep tints in a quarter of an hour, the darkest in half an hour If more expedition is required in the deep tints, it is obtained by the addition of a little more nitric acid, or, on the contrary, slower, by the omission of any proportion. It is recommended, that the plate be well washed after the biting is effected, and that no more of the mixture be made at a time than is required, on account of the volatile nature of the spirit of wine.

"The menstruum should not be more than a quarter of an inch deep on the plate, otherwise it will be difficult to see the work, and it becomes exhausted in about ten minutes, and then requires to be replaced. While it is acting, the work must constantly be swept with a camel-hair brush, in order to remove the precipitated copper, which, if allowed to remain in the lines, renders their edge rugged, and destroys their beauty In stopping out, the ground (Brunswick black) must be laid on very thin, and even By attending to these directions, an etching may be obtained on decarbonized steel, as deep, and quite as sharp, as it can be on copper"—*Abr Trans Soc. of Arts.*

TO CORRESPONDENTS

We feel greatly obliged to LUTHER, for his very handsome proposition, as well as for the paper he has transmitted as a specimen of his intention But as we expect that Mr. Cooper, in continuing his able Chemical Lectures at the London Mechanics' Institution, will immediately devote his attention to a minute illustration of the metals, our Correspondent will perhaps think with us, that the insertion of his papers on the same subject would be superfluous—We are, however, fully sensible of his kindness, and shall be happy to avail ourselves of his assistance on other subjects

UNDER-TIDE's Plan is certainly of a very *striking* description, and displays some ingenuity But we are disposed to think that its practical utility, which we are unable to discover, will be confined to his own tintinnabulatory

A SUBSCRIBER is informed that he may procure asbestus at Mr Knight's, Ironmonger, Foster-Lane, Cheapside

To the inquiry of AMICUS we answer "yes" if he applies at the same place.

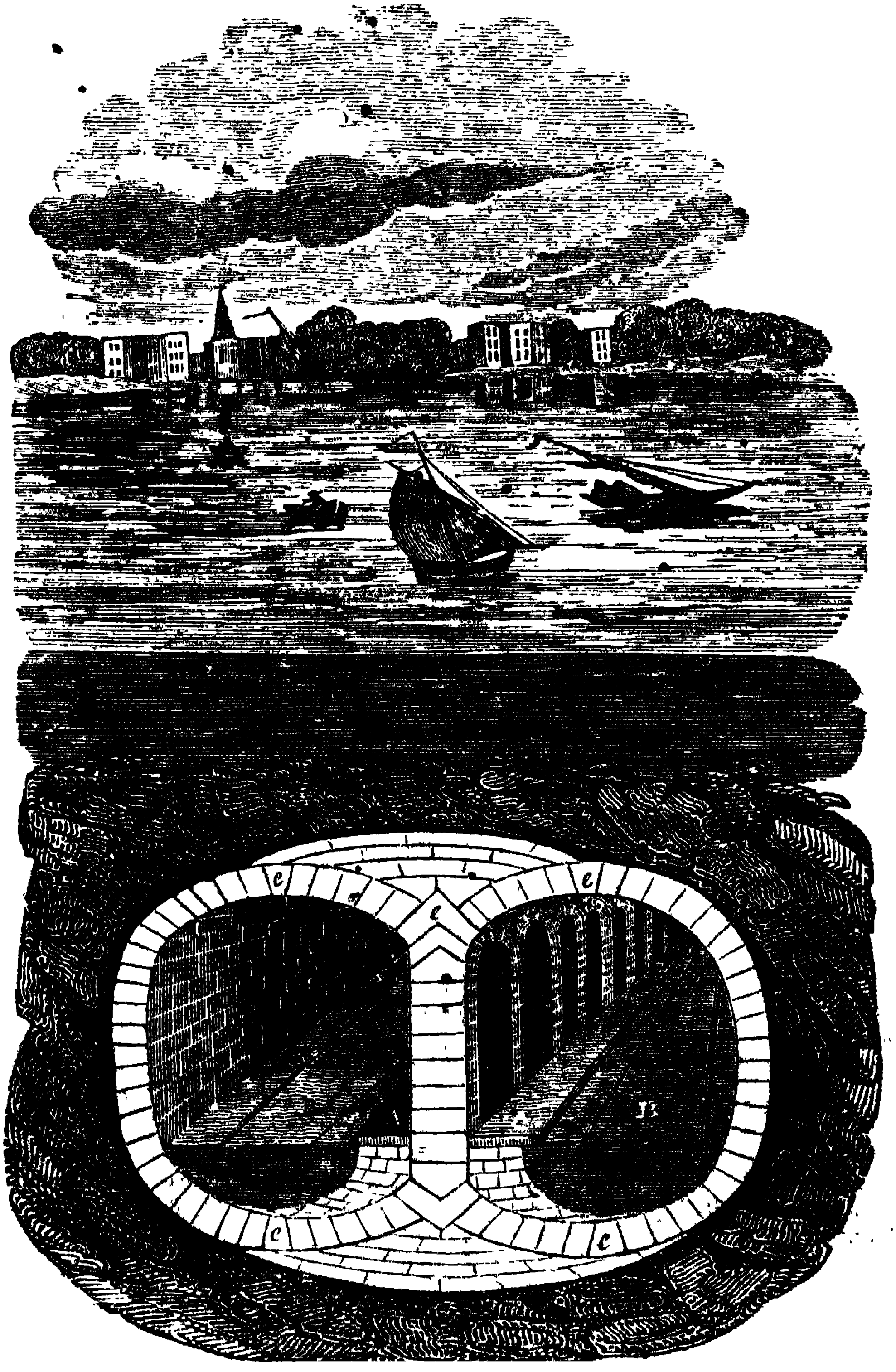
Communications have been received from F M—A Constant Reader—Joseph—T. S. Peigne—G. Solomon—A new Subscriber—W. W—A Member of the London Mechanics' Institution—and several other Correspondents

THE LONDON
MECHANICS' REGISTER.

> "Without care and method, the largest fortune will not, and with them almost the
> "smallest will, supply all necessary expenses."
>
> LORD CHESTERFIELD.

No. 62.] SATURDAY, DECEMBER 3, 1825. [Price 3d.

PLAN FOR A TUNNEL UNDER A RIVER.



MR. JOHNSON'S PLAN FOR A TUNNEL UNDER THE THAMES.

To the Editor of the Mechanics' Register.

SIR,—Observing in your 58th Number a plan for building a Tunnel under a River, by Mr. Dewhurst, who proposes to erect it by driving piles to form a *coffer-dam,* I think it necessary to state that a similar suggestion was laid before the Society of Arts, Adelphi, in the year 1821, and published by me in a periodical work, on the 20th of December, 1823.* I inclose for your perusal the number in which my plan was inserted, and beg to make the following objections to Mr. D.'s plan, as delineated in your Engraving, which, I take for granted, is correctly copied from his drawing. I think, indeed, that Mr. D. can never have seriously considered his plan, and am sorry that he has committed the judgment of his three scientific friends who are gone to Mexico.

First, the stones on the upper part, or top of the Tunnel, are shaped wrong, and would not support their own weight. They should be *wedge-shaped* as at *e e e* in the accompanying drawing, in which A represents the foot-path (3 feet wide); and B, the carriage-road (15 feet wide).

Second, the sides of the Tunnel, if *upright* or *flat*, would be forced in by the great pressure on the outside, and the pillars would be broken by the lateral pressure. The Tunnel that I proposed has pillars in the centre, and also on the sides.

Third, the bottom would be forced, or what is called *blown up.*

Fourth, the loose earth, instead of strengthening the top, would have a directly contrary effect.

Fifth, The Tunnel could not be laid in a quicksand: the bottom of the Sewer, in the New Kent Road, was made of cast iron on that account.

Sixth, Timber could not be procured of sufficient length for the piles. The nearest place at which a Tunnel is wanted, is Blackwall. Now, if we take 32 feet as the depth of the River in the middle at high water, the length of the piles may be calculated as follows:—

	FEET.
Depth of the River..............	32
Earth over the Tunnel..........	5
Thickness of Stones.............	3
Height of Tunnel................	18
Piles below the bottom, to insure their stability................	10
Total length of Piles	68ft.

The plan of the Tunnel at Rotherhithe is good, if it can be executed; and the expense of the requisite machinery is not so great as Mr. D. appears to conjecture.

As the Tunnel now erecting under the Thames, is to be constructed of *brick,* the following questions are, I think, of considerable importance:—

1. If the depth of the river be 30 feet, what is the pressure of the water upon every foot of a tunnel 24 feet wide? and what is the pressure, if the tunnel be 32 feet in width?

2. What is the pressure of earth, 15 feet thick, on each respectively?

3. What should be the thickness of the pillars and arch, to enable them to resist the great pressure of water and earth?

4. What was the cause of the Highgate tunnel falling in?

5. What is the best form of an arch for a tunnel, constructed of *brick?*—ditto of *stone?*

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* The plan proposed by Mr. Johnson, in the publication alluded to, was for constructing a Tunnel of *cast or wrought iron,* in sections, by driving piles for the formation of successive coffer-dams, as the work proceeded. This method was intended only for rivers which were not too deep for the construction of the coffer-dams, and a second plan was suggested by Mr. J. for effecting the same object in deeper rivers by means of the diving bell. It is observed in a communication we have received from a correspondent, who signs himself "AN OLD ENGINEER," that in Dr. Rees's Cyclopædia, Article, *Canal,* section on *Thames River,* Mr. Dewhurst has been anticipated by 20 years in the *impracticable* suggestion, to *pile off* successive short lengths of the River, and excavate therein for laying the Tunnel. ED.

6. What is the best form for one constructed of *cast-iron?*

7. What is the most eligible mode of ascertaining by experiment, on a small scale, the best form of an arch?

As the arches of bridges differ very materially from each other, it would seem that architects are not agreed as to the best form; or whether it should be *semi-circular, elliptical, catenarian,* &c. There is a great difference between a *bridge* and a *tunnel,* as regards the arch. The *bridge* has only to support its own weight, and that of the carriages, &c.; but the *tunnel* will have to support both the earth and the water above it. One cubic foot of fresh water weighs 62½lbs., and at high water, there will be above 25 feet at Rotherhithe; besides which, there will be 30 feet of clay, and the Tunnel is to be 35 feet wide. Can *bricks,* if made of the common, or general form and texture, support such a weight?

I remain, Sir, your's, &c.,
J. JOHNSON,
One of the Committee of the
L. M. Institution.

London, November, 1825.

LONDON
MECHANICS' INSTITUTION.

DR. BIRKBECK'S LECTURE ON VARIOUS MECHANICAL INVENTIONS.

INVITATION TO MECHANICS TO BRING FORWARD THEIR INVENTIONS — MR. COLLINGE'S HINGE—MR. POLLARD'S MACHINE FOR GRINDING COLOURS—. PARALLEL MOTION—TABLE OF THE ELASTICITY OF STEAM AT HIGH TEMPERATURES— MR. GORDON'S ETHER LAMP—MESSRS. TAYLOR AND JONES'S PORTABLE CORN MILL—MR. SCHEFFER'S LIFE PRESERVER — MR. HART'S INSTRUMENT FOR LAYING DOWN ANGLES, &c.—PERPETUAL MOTION— MR. ATTWOOD'S FRICTION WHEELS— ARCHIMEDES—CURIOUS CALCULATION —CONCLUSION.

WEDNESDAY, NOVEMBER 23D.

THE enlightened views developed in the Lecture which, upon the present occasion, we have the satisfaction to submit to our readers, are of so gratifying and exhilarating a nature, that we feel more than ordinary pleasure in making our pages the channel through which they are conveyed to the public. On the self-evident advantages that have already resulted from the diffusion of scientific knowledge, by means of the LONDON MECHANICS' INSTITUTION, it is unnecessary to expatiate; and the prospect of a still further extension of the sphere of its utility, which the following Lecture opens, and in some degree realizes, must possess peculiar claims to the contemplation of the philosopher and the man of science. That the invitation given to the Members by their philanthropic President will be eagerly accepted by them, and many other ingenious mechanics, there can be no doubt: and the Institution, in addition to its former advantages, will thus become the most eligible medium of communication between the humblest artizan, whose inventive genius may dictate improvements in the Arts and Sciences, and that Public to whose patronage he has a right to look for the encouragement due to his merit. Thus many valuable inventions, which; from the circumscribed means of their authors, might otherwise have remained in obscurity; neglected, unpatronized, and unknown, may now be communicated to the world, in a manner which cannot fail to ensure an extensive publicity;—and in this point of view, the present Lecture may, perhaps, be considered as the most important that has yet been delivered to the Members of this admirable Institution.—Dr. BIRKBECK introduced his illustrations of several ingenious pieces of mechanism by the following observations.

Whenever the purposes of this great establishment shall be completely attained, this must become a theatre, conspicuous alike for the display of *practical* and *theoretical* MECHANICS. Within these walls will then be regularly assembled, the inventions of the ingenious Artizan, whether educated or uneducated, if, after the lapse of a few years, any such should be found; and from hence these inventions, if they possess the grand requisite for public acceptance, *practical utility,* will be disseminated through the community, by minds which can comprehend, and hands which can accomplish their construction, to increase the comforts of the prosperous, and to diminish the corporeal toil of the laborious portion of mankind. At different periods, and often perhaps at periods not very distant, such inventions shall, in succession, be brought forward, upon a plan, of which the present occasion may be considered a specimen: a specimen, of course, encumbered with those imperfections which are inseparable from a first attempt, and from the measure being as yet imperfectly known. Designing to undertake this department myself, at least, until your arrangements include a mechanical lecturer, whose leisure and whose acquirements enable him more closely and more scientifically, to watch the movements and collect the productions of inventive genius, *I now invite you, and every other artizan, to bring forward such original pieces of mechanism, or such improvements upon former contrivances, as you or they may now possess, or may hereafter produce*, in order that they may pass through this public, and, I trust, honourable channel, to the knowledge and to the service of mankind; as well as to the establishment of the reputation, at least, of the inventor, if not to the subsequent attainment of a more substantial reward.

Another motive by which I have been influenced in the adoption of this arrangement, I will also venture to make known to you upon this occasion. I have long since and often regretted, that a forbidding distance and untoward jealousy existed between the *theorists*, and the *practical men* engaged in the exercise of the mechanical arts in this country; *and a hope, that this distance may be shortened, and this jealousy eradicated*, has had no small share in promoting the present attempt. By effecting this approximation, I am fully persuaded, that I shall essentially contribute to the improvement of the two disjoined classes; but my views and expectations on this subject, I cannot better express, than by borrowing the language of my very excellent and philosophical friend, Dr. Olinthus Gregory, which forms a portion of the preface to his valuable and comprehensive treatise on Mechanics:—"Admitting the truth of the preceding observations," says he, "it will thence follow, that *theoretical* and *practical* men will most effectually promote their mutual interests, not by affecting to despise each other, but by *blending their efforts*: and further, that an essential service will be done to mechanical science, by endeavouring to make all the scattered rays of light they have separately thrown upon this region of human knowledge, converge to one point. In conformity with these ideas," he continues, "I have undertaken a task," (and I may apply the same remark to myself) "attended, I am aware, with so many difficulties, that even failure will not be disgraceful; while on the other hand, success, if my labours should fortunately be crowned with it, will be doubly gratifying, as I shall then flatter myself with having contributed, in some measure, to the union of *accurate theory* and *judicious practice*, and thus, ultimately, to the promotion of arts and manufactures."

In thus prompting you to perfect and bring forward the productions of your ingenuity, I act under a strong persuasion that you will be amply rewarded, even without the assistance of an exclusive privilege, or the protection, as it is termed, of a *patent*. The public, the British public at least, rejoice in the opportunity of securing to genius the fruits of its labours; and will often, to a great extent, prefer the *original maker*, in the midst of a competition, which actually offers an advantage, from applying to another. Nothing can, in this respect, be more strongly contrasted than the present state of society, and the feelings which appear to have prevailed, when, in the year 1754, the celebrated EMERSON, himself, it must be allowed, much of a *cynic*, or a systematic sort of a grumbler, in the preface to his large work on Mechanics, makes the following gloomy declarations:—"What I have already done, may perhaps be thought too much, in such a nation as this, where natural knowledge wants due encouragement, and where no Mecænas appears to patronise and protect it; and where arts and sciences hang, as it were, in suspense, whether they shall stand or fall; and where public spirit, and English generosity, are just expiring. This decline of arts and sciences is wholly, or in a great measure, owing to the ambition and most extreme avarice of the present age; where men, not being able to lift their eyes above this earth, think nothing worth their care, but raking together the dross it affords; striving, like the toad, *who shall die with the most earth in his paws*. The duller part of mankind are entirely engaged in the pursuit of filthy lucre; and the brighter sort are wholly devoted to low, trifling, and often barbarous diversions. In such momentous concerns as these, it is no wonder if arts and sciences flag, and natural knowledge meet with nothing but contempt; and *Minerva* give place to *Plutus*. And indeed, if the general temper and disposition of men had been the same in all ages, as it is in this, I am in doubt whether we should ever have had any such thing as a mill to grind us corn for bread, or a pump to draw us water."

In describing the several articles which have now, with some difficulty, been brought together, I shall first notice those which relate to a change of the direction of *effort*, or *motion*, or *power*. Of these, the most simple is the *hinge*, the invention of the enterprising Mr. Collinge of Lambeth.

Dr. Birkbeck then observed that he experienced the greater pleasure in laying this specimen of mechanical improvement before the Members, because it afforded a satisfactory proof of the advantages men find by keeping their eyes in their proper places, and *looking* at objects, instead of *over-looking* them. This contrivance originated in an action often carelessly performed, viz.: — *dividing the joint of a fowl's leg*. Observing the accuracy of this *ball and socket joint*, the idea occured to Mr. Collinge to construct hinges upon a similar principle, so that the whole bearing of the hinge might not be on its *surface*, as in the common hinge now exhibited, but that a *globular body* might be made to move in a *socket*, and distribute the bearing over its interior surface. Dr. Birkbeck here exhibited one of Mr. Collinge's hinges, of a size adapted for ordinary doors, and afterwards a larger hinge, beautifully constructed, and suitable for heavy gates, or park doors. A small washer was attached to the first hinge, merely to keep out the dirt, and to the latter was added a contrivance for supplying it with oil, and allowing the dirty oil, if any, to run out. The hinge was further illustrated by a diagram, exhibiting its different parts, by which it appeared, that when the power is applied, the pressure always acts on a spherical surface, and the Lecturer added, that hinges upon this construction have been applied to the rudders of ships, to the machinery of mills, &c.; and, in all cases, have been found to act with considerable advantage.

The next example of the alteration or modification of motion, to which the Doctor adverted, was a machine for *grinding colours*, invented by Mr. George Pollard, of No. 3, Tottenham-Court, New Road, and for which he has obtained a patent. This was not merely a model, but an apparatus of a working size, and the mechanical contrivances by which a combined *elliptical* and *circular* motion was produced at the same time, by simply turning a handle, displayed considerable ingenuity on the part of the inventor. The machine regulates the process of triturating materials ground with oil, and also protects the workman from noxious and injurious effluvia.

With respect to another mode of altering the direction of motion, which the Lecturer had intended to exhibit, he had unfortunately experienced a double disappointment; for the maker had not sent the model, nor the artist the drawings. This was a contrivance by Mr. Johnson, for producing a *vertical motion* in a pump, or piston rod, by a method entirely original. It was his intention to describe the invention, previous to adverting to the model of a Steam Engine now on the Lecture Table, which belonged to the Institution, and had been recently repaired by Mr. Webster, one of the late Committee of Managers. To this Engine is attached the *parallel motion*, invented by Mr. Watt, for the purpose of preserving the motion of the piston rod in a perpendicular direction. As the working beam of the Engine moves on a centre, its extremities must necessarily describe the arc of a circle, but it is evident that the piston, as it moves in the cylinder, must not follow the arched direction of the extremity of the beam. When the steam engine acted only in one direction, the parallelism of the piston-rod was preserved by connecting it with the arch by a chain, but this plan did not answer when the piston was moved both upwards and downwards by the elasticity of steam. Among other contrivances to effect the vertical motion of the piston, under these circumstances, the arched extremity of the beam was furnished with *teeth*, working into a *rack* fixed to the end of the piston rod; but in Mr. Watt's *parallel motion*, a series of levers, forming a parallelogram, are so ingeniously contrived, as completely to counteract each other's motion, so that the point to which the piston rod is attached, constantly preserves its perpendicular direction. This ingenious invention was illustrated by a suitable diagram, and also by the model on the Lecture Table; and Dr. Birkbeck stated that it was first employed by Mr. Watt, in a steam engine, erected at the Albion Mills, London.

Whilst on the subject of the Steam Engine, the Doctor availed himself of the opportunity to speak of a Table which was left unnoticed by Mr. Partington, owing to the multiplicity of facts to which we had occasion to advert, during his able Lectures on that stupendous machine. This table exhibits the great increase of power obtained by employing *high pressure steam*, and is as follows:—

Temp.	Power.
212	1.00
221	1.22
230	1.48
239	1.80
245	2.00
261	2.75
268	3.00
275	3.35
279	3.53
312	5.50

In this table, the elasticity of the steam, generated at the temperature of 212°, the heat of boiling water under the ordinary pressure of the atmosphere, is represented by 1; and the succeeding numbers shew the increase of power obtained by the progressive increase of temperature exhibited in the first column. Thus it appears that the elastic force of steam, heated only to 245° is twice as great as that of steam at 212°; and if it be heated to 312°, its power is increased more than five-fold. It is therefore obvious that, if no other considerations prevented it, the employment of *high pressure steam engines* must be the most advantageous and economical mode of applying steam as a prime mover.

Dr. Birkbeck here observed, that as he had alluded to the subject of *vapour*, he would exhibit an instance of its useful application to the production of *heat*, but not of *power*. This was a lamp, for which a patent had been obtained by Mr. Gordon, of Cornhill, the Patentee of the portable gas-lamp, and consisted of a vessel containing *ether*, which the Members were aware was a very *combustible* and *volatile* fluid. Its escape is prevented by a cap placed over the burners, and the pressure of the atmosphere is hardly necessary in this apparatus, as the ether is converted into vapour at a low temperature, and forms an atmosphere of its own. Metallic, or glass wicks, a small bundle of which accompanies the lamp, are advantageously employed, and by using several burners of this kind, the ether is sufficiently heated to become vapourous, and is ignited in the form of gas, and not of the common fluid. The *ether* here employed is the *pyroligneous ether* obtained from wood, which costs only 7s. 6d. per gallon, while the ether used for medical purposes costs more than 24s. The great heat generated by this lamp was exemplified by placing it under a kettle containing two quarts of water, which it caused to boil in about a quarter of an hour.

The Doctor understood that it was the original plan of Mr. Gordon to apply *alcohol* and the condensed *vapour of tar* to the purpose of illuminating our streets at night; and if this object could be accomplished, the fluid which is at present too often employed to injure man and darken his mind, might become applicable ble to the purpose of his protection, and of illuminating his path in the darkness of night. This, however, could not be effected, except government were pleased to take the duty off *alcohol;* for, as this duty raised the article from 5s. to 24s. per gallon, it was too expensive for illumination; otherwise, the addition of a little of it to a lamp upon Lord Cochrane's construction, would supply light, in many cases, in a manner much more convenient, than by the conveyance of gas through a tube, according to the present arrangement.

Among the convenient and economical contrivances to be submitted to the Members this Evening, is the portable steel corn-mill, for which a patent has been granted to Messrs. Taylor and Jones, of Cheapside. This machine derives some interest from its having been one of the useful, and, at the same time, innocent instruments, which accompanied the army of Napoleon in his tremendous northern expedition; the last, and the overwhelming effort of his insatiable ambition. A working model of this apparatus was exhibited to the audience, and the Lecturer minutely described its operation, and the mode in which the flour, wheat, barley, &c. are ground between two circular steel plates, which may be set to any pitch, according to the coarseness or fineness of the material to be ground. The machine, in the present instance, was set for grinding flour, but for beans, malt, &c. the plates are set at a greater distance from each other, and are kept in their proper position by a pole which falls into the divisions of a ratchet-wheel. The machine is moved by turning a handle, and its motion is regulated by a *fly-wheel*, which, like that of a steam-engine, lays up power to be used when it is wanted. For example, in turning the handle of the present apparatus, the arm exerts its power at greater advantage, and with more force in *depressing*, than in *raising*, the handle; but the momentum communicated to the fly-wheel in the former case, supplies the deficiency of power in the latter, and has the effect of equalizing the force during the who.

revolution. Dr. Birkbeck observed, that the model now exhibited, possessed considerable merit, but he understood that the patentee had introduced some material improvements.

The next invention exhibited to the Members was *Scheffer's Life-preserver*, which our readers will find minutely described in an able letter from Dr. Birkbeck, inserted in our second volume, page 386, together with a series of interesting observations on the buoyancy of the human body, and an engraving illustrative of the utility of this excellent apparatus It was first shewn in an uninflated state, and it was evident that it might, with perfect convenience, be folded up and put into the pocket. Mr. Bluett, the apparatus-keeper, then put it on, and inflated it in about a minute, by blowing through the ivory pipe, and turning the stop-cock, to confine the air within the cylindrical ring which encircled his body below the arms. Dr. Birkbeck observed, that though he should be sorry to lose the services of Mr. Bluett, he should feel no hesitation, if there were a pond of sufficient magnitude at hand, in throwing him into it (*laughter*), for he was satisfied that he would not only be able to keep his head above water, but would find his arms at perfect liberty to put the apparatus upon another person who was not furnished with the same protection.

Dr. Birkbeck now directed the attention of his auditory to the very valuable instrument contrived by Mr. Hart, of Islington, and presented by him to the museum of the Institution. This apparatus is applicable to the purposes of accurately laying down angles to three places of figures, and drawing rectilinear, circular, and elliptical figures. It is also capable of delineating the various figures in geometry, architecture, dialling, the projection of the sphere, perspective, fortification, &c., and of constructing a scale of chords, sines, tangents, and secants. The instrument is of very simple construction, and consists of two concentric circles, the interior circle being moveable within the other, and divided by perpendicular and diameter lines, which are also moveable. Some detached pieces of brass are occasionally added to the apparatus, and, by the motion of the inner circle, and the moveable pieces, any required figure may be described with perfect accuracy. Dr. Birkbeck, assisted by Mr. Christie, the secretary, exemplified the operation of the instrument, by drawing a long ellipsis and several other figures with a pencil attached to the apparatus; and its construction, as well as its effect, was elucidated by several diagrams. Two of these diagrams, were plans of fortifications; one of them drawn in the usual way by scale and compasses, and exhibiting all the numerous circular and other lines necessarily introduced during its delineation; and the other exhibiting the required figure, as produced by Mr. Hart's instrument, without any other lines than those which constituted the figure itself. It was stated by Dr. Birkbeck, that this apparatus is more extensive in its application than any other mathematical instrument yet invented.*

As the attempts of mechanics to discover the *perpetual motion* have not yet been relinquished, the Lecturer hoped to have had an opportunity of introducing to the Members a recent effort of this kind; but it had been intimated to him, that the maker of the machine did not wish it to be exhibited on the present occasion. "Perhaps," added the Doctor, "the machine has *stopped*;" (*laughter*) "the maker, however, states, that he is about to construct a larger model, and if this should not, like its predecessor, exhibit symptoms of obstinacy, I may, perhaps, have the pleasure of laying it before you at a future time."

Dr. Birkbeck now submitted to the audience, as having some connection with the subject of *perpetual motion*, Mr. Attwood's admirable contrivance for diminishing that effect, which, sooner or later, except the power which communicates motion can be renewed, must inevitably stop it. In this ingenious apparatus, the axle of the principal wheel, instead of revolving in the usual manner, rests on the circumference of four other wheels; by which means, a *rolling* is substituted for a *rubbing friction*, and the wheel revolves, for a considerable time, with the application of a very slight motive power. Such indeed is the delicacy of its construction, that, when the direct motion ceases, a slight motion is perceivable in the opposite direction, owing to the inertia of of the supporting wheels. The conformation of this piece of apparatus was peculiarly elegant; it was constructed of brass, by Mr. Styles, a Member of the present Committee, and the ability of the workman did ample justice to the talents of the inventor.

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* Of this ingenious invention, as well as of some others, introduced by Dr. Birkbeck during his lecture, we hope shortly to lay a more particular description before our readers, with suitable engravings explanatory of their construction.—ED.

In all your mechanical expectations, continued Dr. Birkbeck, I must remind you,—and in the approaching lectures of Professor Millington, the hint will be systematically developed, that *what is gained in power, must be sacrificed, or is lost, in time.* When the resistance to be overcome is enormous, the space through which the power moves, if the power be inconsiderable, must be enormous also; and the time employed, unless the velocity be incredibly great, must necessarily be enormous. I shall refer to a striking illustration of these positions.—"*Give me,*" said the greatest mechanic of antiquity, "*a spot upon which I may stand, and I will move the earth!*" This somewhat vaunting declaration, uttered by Archimedes, in the fulness of his confidence in the resources and the powers of his science, when Hiero, king of Sicily, was expressing his admiration and astonishment, on account of the achievements which he had witnessed, might, it appears, from calculation, have been realized. But through how diminutive a portion of space, and with what a prodigious consumption of time, the motion could be accomplished; admitting the intervening machinery to be absolutely perfect, the statement placed before you will sufficiently proclaim.

The statement alluded to by the Doctor was displayed in a large diagram, and contained a curious calculation of the time it would require to move the earth one inch; supposing a force of 30lbs. to be exerted, and to pass through a space of 10,000 feet per hour. The weight of the whole earth being calculated at the ratio of 300lbs. per cubic foot, it appeared that, to raise its enormous weight *only a single inch*, would require the exertion of this power, and at this rate, during the comparatively eternal period of 3,653,745,176,803 CENTURIES!!!

Notwithstanding the suspicion of mechanical empiricism, which this mighty declaration is calculated to awaken, Archimedes was not an empty pretender. He has been justly considered the greatest of the ancient mathematicians; being to them what Newton is to the moderns, to whom, in his genius and character, he bears indeed a strong resemblance. If any evidence of his mechanical skill were required, it would be found in the fact, that he constructed such powerful engines, as enabled the valour of his countrymen to resist, for three years, the whole efforts of a Roman squadron, and besieging army, directed to gain possession of Syracuse. Perseverance and military discipline, however, did at last prevail; and the Roman consul, Marcellus, who conducted the siege at that fatal period, and whose projects had so long been frustrated by the talents of the philosopher, commanded his soldiers, amidst the horrors of the assault, to preserve the life of Archimedes. During the confusion and carnage which ensued, an infuriated soldier entered the apartment of the sage, and, regardless of his solemn occupation, and of the commands of Marcellus, massacred him on the spot. When this event was announced to Marcellus, it has been reported—and this report, so honourable to the feelings of the victorious consul, and so indicative of the high renown of the philosopher, ought never to be forgotten,—that in the greatest agony, he declared *his conquest, by this occurrence, to have been robbed of all its glory;* although fully aware of the vast importance of the possession of Sicily, which the capture of Syracuse insured, as it had long been a favourite object of the desolating ambition of Rome.

Having thus concluded his excellent lecture, amidst the reiterated plaudits of the crowded assembly, Dr. Birkbeck gave notice, that, agreeable to the regulations of the Library of Circulation, all books must be returned on or before Wednesday, the 30th instant, (being one week previous to the Quarterly General Meeting,) or the holders would become subject to a fine of 2*s.* 6*d.* each. The Quarterly General Meeting would be held on Wednesday, the 7th of December, at Eight o'Clock in the evening. He particularly wished the Members to observe, that the hour dictated by the laws was Eight, because some misapprehension had occasionally occurred, owing to the lectures not commencing till half-past eight.

MR. COOPER'S
NINTH LECTURE ON CHEMISTRY.

DR. WOLLASTON'S SCALE OF CHEMICAL EQUIVALENTS—ITS APPLICATION, TO THE PURPOSES OF CHEMICAL ANALYSIS—DECOMPOSITION OF WATER BY THE GALVANIC BATTERY—REUNION OF ITS CONSTITUENTS—ANALYSIS OF AMMONIA — COMBINATION OF CHLORINE AND HYDROGEN TO FORM MURIATIC ACID GAS—SULPHUR—CARBON—COMBUSTION OF CHARCOAL IN OXYGEN GAS—CARBONIC ACID—CARBONIC OXIDE, &c.

FRIDAY, NOVEMBER 25.

Mr. Cooper, on commencing the present evening's Lecture, observed, that in the Philosophical Transactions for the year 1814, a paper was inserted which had been read to the Royal Society, by Dr. Wollaston, on the 4th of November, 1813, on the subject of a scale of *chemical equivalents*. Previous to entering upon a detail of the construction of this scale, and the manner in which it is applied to the purposes of chemical analysis, the Lecturer thought it necessary to give some idea of its extensive utility, which he could not better communicate than by reading part of the paper alluded to. Mr. Cooper accordingly read Dr. Wollaston's introductory remarks as follows:—

"When the nature of any *saline compound* is proposed as the subject of inquiry to an analytic chemist, the questions that occur for his consideration are so varied and so numerous, that he will seldom be disposed to undertake a series of original experiments for the purpose of satisfying his inquiries, so long as he can rely upon the accuracy of those results that have been obtained by the labour of others, who have preceded him in the field of patient investigation.

"If, for instance, the salt under examination, be the common *blue vitriol*, or *crystallized sulphate of copper*, *the* first obvious questions are, (1.) How much *sulphuric acid* does it contain? (2.) How much *oxide of copper!* (3.) How much *water?*—He may not be satisfied with these first steps in the analysis, but may desire to know further the quantities (4) of *sulphur*, (5) of *copper*, (6) of *oxygen*, (7) of *hydrogen*. As means of gaining this information, he naturally considers the quantities of various *re-agents*, that may be employed for discovering the quantity of *sulphuric acid*, (8) How much *barytes*, (9) *carbonate of barytes*, or (10) *nitrate of barytes*, would be requisite for this purpose; (11) How much *lead* is to be used in the form of (12) *nitrate of lead!* and when the precipitate of (13) *sulphate of barytes*, or (14) *sulphate of lead*, are obtained, it will be necessary that he should also know the proportion which either of them contains of *dry sulphuric acid*. He may also endeavour to ascertain the same point by means of (15) the quantity of pure *potash*, or (16) of *carbonate of potash*, requisite for the precipitation of the *copper*. He might also use (17) *zinc* or (18) *iron* for the same purpose, and he may wish to know, the quantities of (19) *sulphate of zinc*, or (20) *sulphate of iron*, that will then remain in the solution.

"These, and very many more questions of the same kind, which it would be tedious to specify, and needless to enumerate, engage the thoughts, and will occupy much of the time of every experimental chemist, unless he can have recourse to some record of former analysis on which he can depend.

"The scale, which I am about to describe," continues Dr. Wollaston, "is designed to answer at one view all these questions, with reference to most of the salts contained in the table; not merely expressing numerically the proportion by which the desired answers may be calculated; but directly indicating the actual weights of the several ingredients, contained in any assumed weight of the salt under consideration: and also the actual quantities of several *re-agents* that may be used, and of the precipitates that would be obtained by each."

Now it must be evident from the quotation just read, that the scale of chemical equivalents, must be of infinite utility; but it is necessary in the first place, to point out the manner in which the scale is constructed. Mr. Cooper here referred to the scale of this description, provided by the Institution, and constructed by himself, for the purpose of public illustration, and measuring 16 feet in length, by 2 feet 6 inches in breadth. The *slider*, which occupies the centre of the scale through its whole length, is moved up and down by means of a pulley and weights attached to the back of the apparatus, and its lower extremity passing through an opening in the floor, it can be readily adjusted to any required height. The divisions on the slider are logometric, corresponding with the line of numbers on Gunter's scale, and the names of the various simple and compound substances are placed opposite to their equivalent numbers on the slider, and are to be considered as so many gauge points.

In the scale exhibited by Mr. Cooper, *hydrogen*, the lightest of all ponderable bodies, is assumed as the unit from which the weights of other substances are calculated. In Dr. Wollaston's scale, the unit is *oxygen*, but Mr. Cooper and many other practitioners adopt *hydrogen* in preference to *oxygen*, because all the other substances are designated by *multiples of unity*; whereas, by using *oxygen* as the standard of comparision, the necessary consequence is, that the equivalent numbers of other bodies are, for the most part, expressed in *fractional parts.*

Mr. Cooper now proceeded to an experimental illustration of the scale of chemical equivalents, observing that it is a general rule in chemical analysis, to make use of substances whose constitution is known, to determine the nature of those which are unknown: —*water,* for instance, has been ascertained to be a compound body, the constituents of which are *oxygen* and *hydrogen;* and it is proved by analysis that these substances combine in proportions, which are uniformly constant. If a portion of *water* be made the medium of communication between the opposite poles of a galvanic battery, it will be found, upon completing the connection between the poles of the battery, and the apparatus containing the water, that an immediate chemical action will ensue, and the water will be decomposed into its elements. The Lecturer here directed the attention of the audience to the apparatus before him, which had already been in action for some considerable period, in order to procure the requisite quantity of gases necessary to render the experiment evident, and having requested them to observe, that two vessels were attached to the apparatus, for receiving the disengaged gases, one of which vessels contained twice as much gas as the other, he inquired which of the gases was the largest in quantity?

"*Hydrogen,*" was the reply immediately given by one of the Members.

Mr. Cooper observed that the answer was perfectly correct; as water is composed of two volumes of *hydrogen* to one of *oxygen.* The wires of the galvanic battery, which was arranged round the bottom of the lecture table, and consisted of about 200 four-inch plates, were then connected with the apparatus, when numerous bubbles were instantly formed at the points of the wires, and the two gases ascended into the glass vessels provided for their reception. This beautiful experiment was continued for some time, and the Lecturer remarked, that it might be prolonged till the whole of the water was decomposed; but as this operation would occupy a considerable period, he had previously made the exriment, and would reason upon this fact, during the lecture.

It has now been seen, that *water,* by the agency of voltaic electricity, has been resolved into two gaseous bodies; but in order to apply this decomposition to the scale of chemical equivalents, it is necessary to consider, that the weight of *oxygen,* compared with that of *hydrogen,* is as 16 to 1. But as two volumes of *hydrogen* combine with one of *oxygen,* to form *water,* it follows that *one volume* of the former combines with *half a volume* of the latter; and, therefore, if *hydrogen* be represented by *unity,* as it appears in the scale, the equivalent number of *oxygen* will be 8; and the resulting compound, water, will be expressed by the sum of these two numbers, or 9.

The Lecturer then demonstrated, that the two gases, liberated by the decomposition of water, were really *oxygen* and *hydrogen;* and observed that he was the more particular upon this point, because many Members were present, who had not the opportunity of attending when this subject was discussed at their former lecture room, in Monkwell Street. Mr. Cooper first examined the larger of the two vessels, and turning its mouth upwards, he applied a light to it, when it instantly exploded, and burnt with the faint lambent flame, for which hydrogen is distinguished. A taper, previously blown out, was then immersed in the gas contained in the smaller vessel; and though the oxygen had been produced in too small a quantity to light the taper again, the presence of this gas was indicated by the momentary increase of brightness which took place in the half-ignited wick.

The re-formation of *water,* by passing the electric spark through the two gases, mixed in the proportions already mentioned, in a vessel, previously exhausted of air, was then successfully exhibited; and the Lecturer referring to the scale, and pointing out the equivalent numbers of *hydrogen, oxygen,* and *water,* observed that this example would explain the foundation upon which the whole fabric was constructed.

The Lecturer next performed the experiment of effecting the decomposition of *ammonia,* by passing the gas through a red-hot tube, which had failed on the preceding Friday, from the want of sufficient heat in the furnace employed (Vide pp. 73, 74, for a description of the apparatus). Upon the present occasion, the experiment was successfully performed; and the *ammonia,* becoming decomposed into its constituents, viz., *hydrogen* and *azote,* in the proportion of three volumes of the former to one of the latter, was enlarged to twice its former bulk; thus affording a demonstration, that the four volumes are condensed into two, by their union in the form of *ammoniacal gas.* Mr. Cooper then transferred a portion of the mixed gases into another vessel, and introduced into it a piece of moistened turmeric paper, to shew that the *ammonia* had lost its *alkaline* properties by decomposition. The colour of the turmeric paper was very slightly changed, and the Lecturer observed, that if the operation had been continued a little longer, not the least indication of the presence of an *alkali* would have remained.

Ammonia, then, being constituted of three volumes of *hydrogen* to one of *azote*, it will not be difficult to ascertain, from the specific gravity of *azote*, its equivalent number, which is 14 on the scale; and this number, added to the number of volumes of *hydrogen*, gives 17 as the number representing *ammonia*.

The next substance which Mr. Cooper noticed, was *chlorine*, one of the supporters of combustion. The weight of *chlorine* is to that of *hydrogen*, as 36 to 1, and, therefore, the number 36 represents its atom on the scale. If we add to a volume of *hydrogen* an equal volume of *chlorine*, the two gases combine without any condensation of volume, and a new gas is produced by their union, called *muriatic acid gas*. Mr. Cooper then passed up equal volumes of *hydrogen* and *chlorine* into an exhausted exploding vessel, observing, that no action takes place between the gases, except they are exposed to a high temperature, or exploded by the electric spark. The spark was then passed through the mixed gases, and their combination was immediately effected, though the effect differed materially from that produced by the union of *hydrogen* with *oxygen*, in which case the gases disappeared, and *water* was formed. In the present instance, no condensation occurred, as the vessel remained filled with gas, though of a character essentially different from those of which it was constituted. The Lecturer admitted a small quantity of water into the vessel, and agitated it in contact with the *muriatic acid*, when the vessel became filled with dense white fumes; and the whole of the gas was rapidly absorbed by the water, which is not the case with either of its constituents. The acid character of the compound was proved by its reddening litmus paper, and its equivalent number on the scale is 37, which is formed by adding together the weights of the volumes of *chlorine* and *hydrogen* that have combined, viz., 36 and 1.

With respect to the atomic weight, or prime, or equivalent, (for the same thing is differently designated, by different authors,) of *sulphur*, Mr. Cooper observed that there is found, in various parts of the world, a mineral called *galena*, or native *sulphuret of lead*; but in whatever place this substance is found, the proportionate quantities of *sulphur* and *lead*, which enter into its composition, are invariably the same, and this circumstance affords one means of ascertaining the equivalent of *sulphur*; but as he had not yet entered upon an illustration of the metals, Mr. Cooper deferred this subject till a future period, and had recourse to the decomposition of *sulphuretted hydrogen*. An exhausted globular vessel, in which a charcoal point was suspended, was filled with this *fragrant* gas, and the poles of the galvanic battery being connected with the apparatus, the charcoal was ignited, and its combustion, which exhibited a very beautiful appearance, was continued for some time. The vapour of *carbon*, entering into combination with the *hydrogen* of the compound gas, formed *carburetted hydrogen*, while its *sulphur* was liberated. The atomic weight of *sulphuretted hydrogen* is 17 in the scale; and if from this number we deduct 1, the equivalent of *hydrogen*, we obtain 16, as the weight of the atom of *sulphur*.

There remains but one more substance to which it will be necessary to advert at present, as a further illustration of the scale of chemical equivalents, and that substance is *charcoal*. It has been shewn, in a former lecture, that there are two compounds of *carbon* and *oxygen*, viz. *carbonic oxide* and *carbonic acid*; the former containing two volumes of *carbon* to one of *oxygen*, and the latter consisting of equal volumes of the two constituents. Now, as *carbon* and *oxygen* unite in equal volumes, to form *carbonic acid*, without any enlargement or condensation of volume, if from any quantity of *carbonic acid* we subtract the quantity of *oxygen*, we shall arrive at the atomic weight of *carbon*. To shew that no increase of volume takes place, during the combination of *carbon* and *oxygen*, to form *carbonic acid*, Mr. Cooper filled an exhausted glass vessel with *oxygen*, and having ignited a piece of *charcoal*, by the electric spark, he exhibited the beautiful experiment, of the combustion of *charcoal in oxygen*. The charcoal continued to burn with great splendour, emitting innumerable coruscations of vivid light, till the whole of the oxygen was consumed; and as the vessel was greatly heated during the process, the Lecturer observed, while it was cooling, that, as *carbonic oxide* contains less *oxygen* than *carbonic acid*, it requires the addition of a portion of *oxygen*, equal to half its volume, to convert it into *carbonic acid*; and when the additional quantity of *oxygen* is combined with *carbonic oxide*, the resulting compound is precisely the same as that produced by the direct union of *carbon* with *oxygen*, exhibited in the experiment.

It will be observed, that part of the *charcoal* in the vessel remains unconsumed; from which it may be concluded that the whole of the *oxygen* is saturated, and that there was not a sufficient quantity of *oxygen* to enter into combination with the whole of the *carbon*. In the scale of chemical equivalents, 22 represents *carbonic acid*; and if from this number we deduct 16, for two volumes of *oxygen*, the remainder 6, will designate the equivalent of the *vapour of carbon*, which is placed opposite the latter number in the scale. The Lecturer then introduced into the vessel a quantity of *lime-water*, which rushed into it like a small fountain; and, upon agitating it with the gas contained in the vessel, it absorbed the *carbonic acid*, and assumed the turbid and opaque appearance, which always results from the contact of these two substances.

Mr. Cooper concluded his lecture by observing, that he had merely selected a few substances for the purpose of illustrating the construction of the scale of chemical equivalents; but there remained many other bodies, whose equivalents would be referred to, as they were successively brought under consideration in future lectures.

We mentioned, about three or four weeks since, that a placard was exhibited in the Theatre by a very zealous and intelligent Member of the Committee of Managers, conveying "A HINT" to his brother Members, which, if properly taken, would produce a very important addition to the Library of the Institution; and it affords us much satisfaction to be enabled to state that, previous to the above Lecture, a similar mode was adopted of conveying to the Members "*A report of the hint*," from which it appeared that no less than TWO-HUNDRED AND TWENTY VOLUMES had been presented to the Library since the "hint" was given. The Report concluded by an intimation, that as this valuable addition had been made to the Library, by only 42 of the Members, there remained rather a large balance of Non-Subscribers; but we trust that the beneficial effect which has already resulted from the "hint," will stimulate the rest of the Members to follow the excellent example which has been set before them, and to promote, as far as their means will allow, one of the most important objects of the Institution, the formation of an extensive *Library of Reference and Circulation*.

In addition to the very liberal donations of Books above alluded to, we feel great pleasure in stating that, on Monday Evening last, the following Donations were presented to the Institution, by John Martineau, Esq. one of the Vice-Presidents:—

	£.	s.	d.
Messrs. Whitbread and Co. ..	52	10	0
Messrs. Truman, Hanbury, and Co.	52	10	0
John Martineau, Esq.........	10	10	0
	£115	10	0

LECTURE FOR NEXT WEEK.

Friday, December 9th. Mr. Cooper's Tenth Lecture on Chemistry.

ROTHERHITHE AND BERMONDSEY MECHANICS' INSTITUTION.

On Monday evening last, one of the most numerous meetings that have hitherto assembled for similar purposes, was held, on the premises of Mr. Blackburn, in Cherry-garden Street, Bermondsey, to take into consideration the propriety of establishing a Mechanics' Institution, for the parishes of Rotherhithe and Bermondsey Drs. Birkbeck, Mitchell, and Black, Robert M'William, Esq., and several other distinguished patrons of science, were present.

It was expected that Mr. BRUNEL, the eminent engineer, under whose directions the Thames Tunnel is erecting at Rotherhithe, and who has consented to act as President of the Institution, would have presided at this meeting; but that gentleman being prevented, by illness, from attending, Mr. Brent was unanimously called to the chair, and opened the business of the evening by a brief but distinct statement of the beneficial purpose for which it had been called.

Dr. Birkbeck then rose to move the first resolution, declaratory of the beneficial effects of Mechanics' Institutions, and was received with rapturous applause. He said, it was with the greatest satisfaction he complied with the application of the friends of human improvement in Rotherhithe and Bermondsey, to propose the first of a series of resolutions, having for their object the formation of a Mechanics' Institution, calculated to add to the sum of human knowledge and happiness. Till lately, it was thought, that to attempt to make mechanics wise, or philosophical, was as wild as it would be to attempt to discover the philosopher's stone. But it was no longer a matter of argument that mechanics became wise and philosophical, and were, by their increased knowledge, improved in the practice of their respective arts, and their general habits. The art of ship-building, in which a large proportion of his auditors were engaged, had occupied the attention of the most scientific men. Archimedes investigated the laws of floating bodies, and it had ever since been an object of attention to scientific men. The distinguished mechanic, Mr. Brunel, who was to have presided at the meeting, had, by his scientific improvements in the Dock-yard of Portsmouth, produced such mechanical wonders, that, to the spectator, it almost appears as if the machines were intelligent agents, and the man by whose ingenuity they are governed, but a mere observer of their operations. And those who could not go to Portsmouth, might, by a short walk to the tunnel that is constructing under the Thames, admire the effects of that scientific skill by which we shall be enabled to pass under the river on dry land. The steam engine, that had effected more for the advancement of human power and happiness than any other effort of human invention, was the production of a mechanic enlightened by science. The elementary instruction would prepare the Members of the Institution for the lectures, and the union of both would highly improve their condition as moral and intellectual beings.

The Resolution was ably seconded by Mr. M'William, and, to the apparent surprise of the audience, was strenuously opposed by a young man, whose name, we understood, was Thomas. He observed that the present *furious fanaticism* for educating the people would be *the ruin of them and of the state*. It would enervate their bodies, and render them unfit for their proper avocations; would depress the higher classes; it was not true that Mechanics could perform their work better by being philosophers; he could see nothing but evil in the attempt to improve their minds, or their condition, by communicating knowledge of which they did not stand in need. He concluded by moving, "That it was not desirable to establish the proposed Institution."

This absurd speech was heard with strong symptoms of impatience by the Meeting, and for some time no person was found to second it. A Mr. Cornthwaite at length said he would second it, as he agreed in opinion with Mr. Thomas.

The question on the amendment was then put, when *five* hands were held up; and the original motion was then carried by an overwhelming majority.

Mr. Elliot, who moved the second Resolution, ably replied to the objections urged by Mr. Thomas. He had not anticipated any opposition, as he could not conceive that the meeting would be attended by any one who would deny to others the benefits of education which himself enjoyed. But he would only number in his list of friends, those friends of man whose benevolence included the whole human race. He would tell the timid Statesman who trembled at knowledge, that the most dangerous of all volcanoes was that whose crater was crammed with an ignorant population. (*Hear, hear.*)—The Mechanic possessed all the faculties necessary for the attainment of knowledge, and who would say that when he had acquired it, he would not be as industrious and as prudent as if he were ignorant? He concluded an excellent speech by moving "That this Meeting acknowledges with approbation the example which the Mechanics of the Metropolis have set their brethren at large, in having established an Institution for their own instruction in the arts and sciences."

Mr. Donkin seconded the resolution, which was carried with great applause.

The remaining resolutions, for establishing the Rotherhithe and Bermondsey Mechanics' Institution, &c., were moved and seconded by Drs. Mitchell and Black, Mr. Lewthwaite, &c., after which, thanks were voted to the Chairman, and to Dr. Birkbeck, and the other gentlemen connected with the London

Mechanics' Institution who had attended the Meeting.

Dr. Birkbeck, in returning thanks, defended the promoters of Mechanics' Institutions from the charge of *furious fanaticism*. He had assisted in the formation of such an Institution in Glasgow, after which his fanaticisms had slept for twenty years, and assuredly it would never have revived had he not seen the most beneficial effects produced by the first institution.

The result of the proceedings afforded very general satisfaction, and the Meeting was adjourned about half-past Ten o'Clock.

HAMMERSMITH, KENSINGTON, AND CHISWICK MECHANICS' INSTITUTION.

The Provisional Committee of the proposed Mechanics' Institution for the above Districts, have been indefatigable in their exertions since we noticed their appointment a few weeks since; and we are happy to find that their preliminary arrangements are in such a state of forwardness, that a public meeting is appointed to be held on Monday evening next, at 7 o'clock, at the Sussex Hotel, Hammersmith, for the purpose of formally establishing the Institution. Dr. BIRKBECK, and several other scientific gentlemen, are expected to honour this meeting with their presence, and we trust that their eloquence will produce, at Hammersmith, the same beneficial effects that have resulted from similar exertions in other districts in the vicinity of the central Institution.

ON A NEW KIND OF TRACING PAPER.

To the Editor of the Mechanics' Register.

SIR,—As I apprehend that one of the principal objects of your work is to disseminate, as widely as possible, every information relative to the arts and manufactures, and to give publicity to every useful invention, I am induced to send you an account of a very curious description of tracing paper, lately invented and used by the artists of Paris. There are few persons connected with the arts, and particularly engraving, but must be aware of the importance of possessing a correct trace, and have experienced a difficulty in procuring paper sufficiently transparent for the purpose. Various experiments have been made with a view to render paper perfectly clear, and of a quality that will allow of the finest lines being drawn with a pen or pencil, but no attempt has yet been made to produce paper that will allow of the use of the point.

Where extreme accuracy is required, both the pen and the pencil are objected to; and the point is always preferred when it can be used.

To those who are at all acquainted with engraving, any further observations will be unnecessary; and to those who are desirous to know the peculiar properties of this paper, and the various purposes to which it can be applied, I beg leave to refer them to the description given by the maker to the gentleman who presented it to me. As it is but little known in this country, and as it appears to possess some very valuable properties, and to be superior to any paper I have yet seen, I presume that the following account of it will not be unacceptable to your readers.

EYLNU ENON.

TRANSLATION.

"Instructions for using the Glass Paper invented and made by Mr. QUENEDY, Engraver, *Rue neuve des petits Champs, No. 15, a Paris.*

"On placing the paper over the design, you must take a sharp and fine point to trace every part of your design, and afterwards rub it gently over with black lead dust for engraving, and with black or red chalk for drawing. After having carefully wiped it with a linen rag, you turn it over the varnished plate, and pass it by a single turn through the press lightly covered with soft and dry linen.

"When it is for drawing, it must be placed on white paper over a polished plate, and pressed lightly through the press. Without a press you may obtain a trace by rubbing it over every part with a burnisher on a copper-plate, a marble table, or any other thing equally hard and smooth.—When you would have a trace the same as the original, you must trace on the worst side of the paper, and rub it with black lead chalk, then turn it on white paper to see the trace, and make another on the other side. This second trace will produce one the same as the original.

"You may also trace with black lead or or any other black crayon, after having rubbed one side of the paper with fine stone powder sifted, and afterwards the black lead will easily mark on it. You will obtain a trace less clear by this means; but you may easily efface it, either by the rubber, or with the stone powder, and by this means make as many as you please. You may, if you prefer it, use Indian Ink; but you must be careful to prevent any water from falling on the paper. A miniature may be traced and transferred on Ivory. You may, even, with the same trace, produce several, by printing it on dry paper. This paper is also very convenient for tracing on stone by rubbing it on the back with a burnisher, after having well fastened it at the corners of the stone."

LAWS OF MOTION.

To the Editor of the Mechanics' Register.

SIR,—Like JUVENIS ADMIRATOR, "I am no great mechanic or mathematician," but the author, whose book is now open before me, is both the one and the other; I will therefore oppose to the light shafts from the witty bow of N. R., the impenetrable buckler of my author's learning, and endeavour to shield Juvenis Admirator from unmerited ridicule, while I take the same opportunity to fire a shot at his antagonist. Juvenis Admirator is *accused* by his antagonist, of having *found* the perpetual motion; now, I may venture to affirm that the supposition of Juvenis Admirator, when he speaks of one ball rising to the same height as the other, is, that the elasticity of the balls is perfect. (Juvenis Admirator should not have made use of *ivory* balls, but should have used balls *generally* as an illustration.) It is usual in explaining a principle of this nature, to suppose the elasticity perfect, to render the illustration more simple. To prove that the bodies would exchange velocities, I refer N. R. to Dr. Wood's excellent (though limited) treatise on mechanics. I conceive that N. R. requires a *little more reading* on this subject, when he mentions gravitation as tending to destroy the motion. In order to render the case more plain, I must premise, that whatever effect gravity produces to stop the ball, as here described, the same would be produced in the case of *one ball alone*, oscillating in circular arcs.

Now, in the case of the ball, gravity not only produces no effect to stop the pendulum, but, on the contrary, is the very cause of its motion; I will not now enter into a mathematical investigation of the case, as I think mathematics are foreign to a popular work like yours; but in confirmation of what I affirm, will remind N. R. that the time of oscillation of a pendulum = (circumference of circle radius = 1)

$\times \sqrt{\frac{\text{length of pendulum}}{\text{force of gravity}}}$. Hence, the greater the force of gravity, the quicker goes the pendulum.

I am, Sir,
Your's, most respectfully,
Nottingham, Nov. 29. F. M.

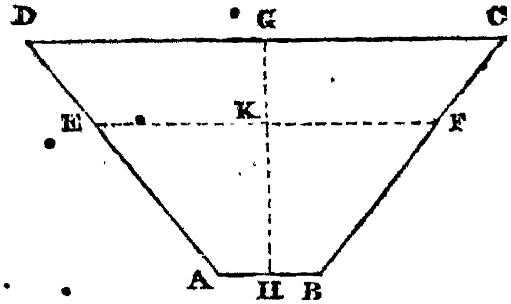
ANSWERS TO QUERIES.

QUERY, No. 94, Vol. II Page 319.

To the Editor of the Mechanics' Register.

CONTENTS OF A RESERVOIR.

SIR,—I beg leave to submit the following algebraical solution to the Reservoir Query, (Page 319, Vol. II.) in addition to that already received from T. H——h, (Page 46, present Volume), not wishing to depreciate that of the latter, but to shew the variety of solutions incident to such problems.



DC = 40; AB = 8; the perpendicular GH = 20; let GK be the depth of water the first party must pump out; which put $= y$; and put $EF = x$; and $KH = 20 - y$.

Now by Mensuration, the area of a trapezoid is equal to half the sum of the parallel sides, multiplied by their perpendicular distance; ∴ the area of the trapezoid ABCD is $= \frac{1}{2}.(40+8).20 = 480$.

But the trapezoids ABFE, EFCD, are each equal to half ABCD, or $= 240$.

$$\text{Consequently } \tfrac{1}{2}.(EF+CD).GK = 240,$$
$$\text{and } \tfrac{1}{2}(AB+EF).KH = 240,$$
$$\text{that is } \tfrac{1}{2}(40+x)\,y = 240,$$
$$\text{and } \tfrac{1}{2}(x+8).(20-y) = 240,$$

multiplying by 2. $40y + xy = 480$.
and $20x - xy + 160 - 8y = 480$,
by transposition $20x - xy = 320 + 8y$,
and $xy = 480 - 40y$,

by division $x = \frac{480 - 40y}{y} = \frac{320 + 8y}{20 - y}$,

clearing of fractions $9600 - 1280y + 40y^2 = 320y + 8y^2$,
transposition $32y^2 - 1600y = -9600$,
dividing by 32 $y^2 - 50y = -300$,
Completing the Square, and extracting the Root,

$$y - 25 = \pm\sqrt{325},$$

$\therefore y = 25 - \sqrt{325} = 6.972243623 = GK$; which is the depth of water the first party must pump out.

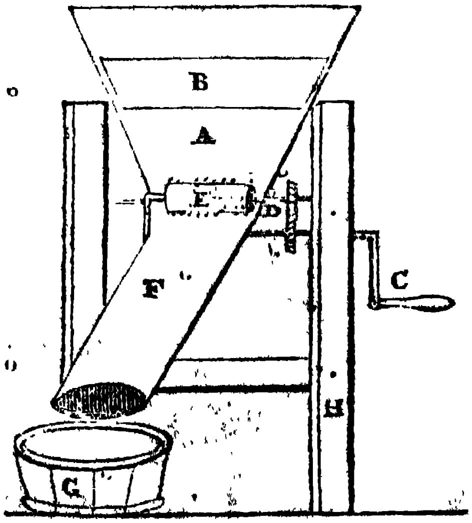
The price of pumping out the whole is found in a manner similar to that of T. H——h.

I remain, Sir,
Your's respectfully,
H——y P——e.
Of the Mathematical School at the L.M.I.

QUERY, No. 116, Vol. II. Page 383.

MACHINE FOR GRINDING POTATOES.

SIR,—Inclosed is a drawing of a machine of my own invention, which I transmit to you in answer to your correspondent, GUILLETT, and which I hope will answer his purpose. By this apparatus, he can grind any quantity of potatoes he thinks proper, and, at the same time, it is very portable, as he can have it made as large or as small as is convenient.



The mode of using it is follows:—Put the potatoes in the funnel, A, which is supported by the frame, H; press them down with the weight, B, and turn the handle, C, which, by means of two cogs, D, turns the grater, E. The potato pulp then falls down the shoot, F, into the tub, G, from which it is to be used for the purpose desired. The weight may be made of lead, or any other heavy substance, as stone, &c. The pulp can be washed out of the shoot by pouring water down the funnel.

Your obedient servant,
HENRY WILLIAM DEWHURST.
26, *Prince's Road, Kennington Cross.*

NOTICE TO CORRESPONDENTS, &c.

The highly important proceedings at the Second Anniversary Dinner of the LONDON MECHANICS' INSTITUTION, which was celebrated yesterday, at the Crown and Anchor Tavern, together with the proceedings of the Quarterly General Meeting on Wednesday Evening next; the Eighth Report of the Committee of Managers, &c., will occupy a considerable share of our attention next week; and in order to realize the expectations of our Subscribers, by giving a correct and satisfactory account of those interesting meetings, we intend to publish, on Saturday next, a DOUBLE NUMBER, which will complete the 2d Monthly Part of the present volume.

We shall be enabled, by this arrangement, to insert the communications of several correspondents, whose favours have been necessarily postponed for want of room; and we feel much pleasure in adding, that the number will contain a valuable Letter from DR. BIRKBECK, prefixed to an interesting paper, by Mr. GORDON, explanatory of his Theory of Thunder Storms.

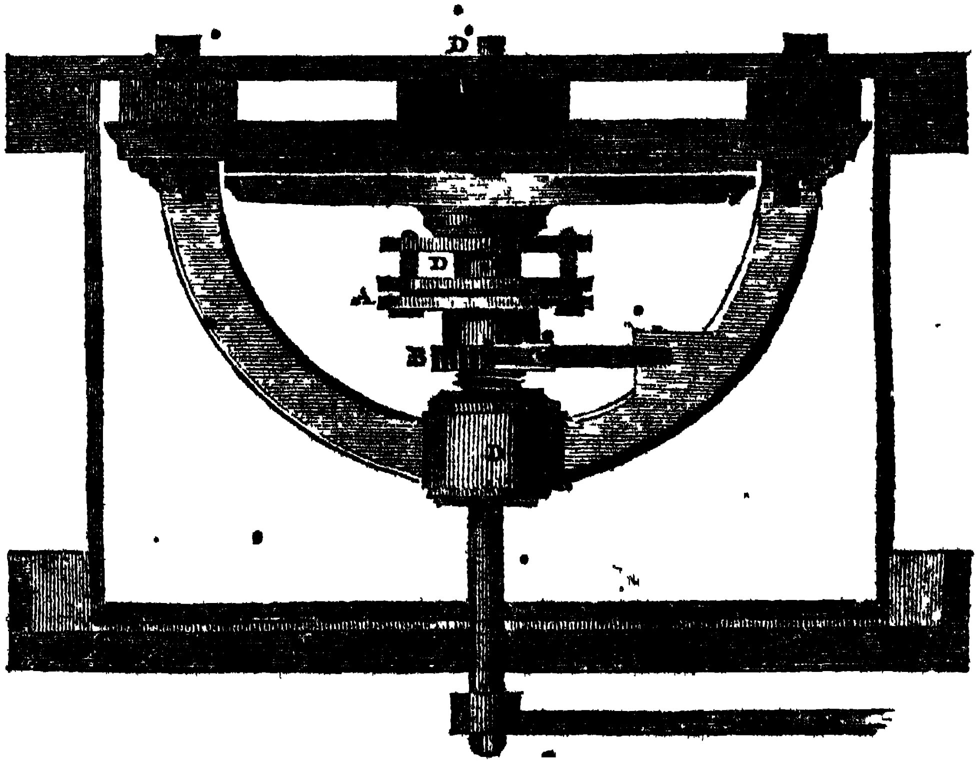
THE LONDON

MECHANICS' REGISTER.

> " Full are thy cities with the sons of art ;
> " And trade and joy, in every busy street,
> " Mingling are heard · even Drudgery himself,
> " As at the car he sweats, or dusty hews
> " The palace stone, looks gay."
>
> THOMSON.

N°. 63.] SATURDAY, DECEMBER 10, 1825. [Price 3d.

TAYLOR AND JONES's PATENT PORTABLE STEEL CORN MILL.



MESSRS. TAYLOR AND JONES'S PATENT PORTABLE STEEL CORN MILLS.

In our report of Dr. Birkbeck's Lecture on various Mechanical Inventions, delivered on the 23d ult. to the Members of the London Mechanics' Institution, and inserted in our last Number, we intimated our intention of submitting to our readers a more particular description of some of the ingenious contrivances adverted to by the learned Lecturer, with engravings to illustrate their construction. In pursuance of this design, we this week give a correct representation of the Circular Steel Corn Mill, for which a patent has been granted to Messrs. Taylor and Jones, of Cheapside, and which they describe as comprehending several important improvements on the *French Military Mill*, which formed part of the camp and field equipage of the immense army with which Napoleon invaded the Russian empire in the year 1812,—an expedition which, for the vast ambition which dictated it, the gigantic efforts by which it was organized, the military skill and experience of its conductors, and, finally, for the combination of disastrous events which characterized its progress, and terminated in its utter failure, is, perhaps, unparalleled in the annals of history.

The general construction of the Improved Patent Mill will be clearly understood by a reference to the Frontispiece, which exhibits a section of the apparatus, in the upper part of which are fixed the circular steel plates for grinding the corn, &c to any degree of fineness that may be required. These plates are adjusted to different distances from each other by means of the regulator A; and, in order to regulate the mill, the pole C is first lifted out of the ratchet-wheel B, and the regulator is then moved to the *right*, if the mill is to be set fine, for grinding flour, &c., or to the *left* for the purpose of setting it coarser, for malt, beans, oats, &c.—When the mill is properly adjusted, the pole C is let fall into one of the divisions of the ratchet wheel B, by which means the plates are effectually fixed in the required position, and at whatever distance may be necessary, according to the quality of the material to be ground, which is introduced between the plates through a hopper. The fly-wheel, to equalize the motion of the machine, is attached to the end of the spindle at D, and the mill is turned by a handle at the opposite extremity.

To ease the friction of the spindle and make the mill work easy, it is absolutely necessary to apply fine oil frequently to the points marked D in the figure, and if a small stone, or other hard substance, should get between the plates, and check the working of the mill, it can be instantly removed by simply turning the regulator to the left, by which means it will drop out.

To clean the mill before using it for *flour*, a few handsful of common grain may be run through the plates two or three times, which will remove any dirt that may have settled between them, and care should be taken not to set the mill too tight, as the labour of working it is increased, and not only the faces of the plates are unnecessarily worn, but the vegetable quality of the wheat is, in some measure, deteriorated. A key is supplied by the Patentees for taking the mill to pieces, if necessary, or putting it together again, which operations, from the simplicity of its construction, may be performed with perfect ease, and require no additional directions

These mills, from their portability and the excellent principles upon which they are constructed, are peculiarly adapted for private families, boarding schools, &c, and they are not only capable of producing flour of the finest quality, but are applicable to the purposes of grinding every sort of grain, rice, coffee, spices, drugs, &c

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DR BIRKBECK'S OBSERVATIONS ON MR GORDON'S THEORY OF THE THUNDER STORM.

To the Editor of the Mechanics' Register.

Dear Sir,—The inclosed theoretical sketch of a curious and awful natural phenomenon, was, some weeks since, put into my hands by its author, an ingenious medical practitioner in the city He has, by various circumstances, been directed to the consideration of the combustion of hydrogen gas; and, so far as regards himself, I am satisfied that the opinions are original.

To many of your readers, I believe,

this train of thought will be quite new; unless, indeed, they should recollect an experiment detailed in the report of one of Mr. Lewthwaite's lectures, consisting of the explosion, by means of electricity, of a mixture of oxygen and hydrogen gas, confined in a bladder, and placed near the roof of the lecture-room; consequently, at a great distance from the electrical machine. Many years ago, this idea of the nature of thunder was advanced by Volta, in the Journal de Physique; and I well remember the able expansion of his opinion, by Mr. Erskine, one of the Members of the Academy of Physics, founded by Mr. Brougham, the late Mr. Horner, Dr. Leyden, Dr. Thomas Brown, Mr. Erskine, and myself: the records of which have lately been submitted to the public, in the interesting life of Dr. Brown, the splendid professor of moral philosophy in the University of Edinburgh, who was our secretary. During three sittings, the elaborate essay of Mr. Erskine was discussed; and, I believe, (but here I rely wholly upon my memory), the general opinion was favourable to the doctrines advanced by Dr. Franklin, and maintained by nearly all his electrical contemporaries.

Prior to the times of which I have spoken, Dr. Darwin had distinctly expressed a similar opinion. In a note to the 553d line of the first canto of the Botanic Garden, he observes, "If we may trust the theory of Mr. Lavoisier, concerning the composition and decomposition of water, there would seem another source of thunder showers;—and that is, that the two gases termed oxygen gas, or vital air, and hydrogen gas, or inflammable air, may exist in the summer atmosphere in a state of mixture, but not of combination; and that the electric spark, or flash of lightning, may combine them, and produce water instantaneously." In other notes he employs the same imaginary, but then probable strata of this very light gaseous fluid, for the explanation of other meteors, such as falling stars, the Aurora Borealis, and the like.

It is not my intention critically to investigate the validity of the theory of Mr. Gordon, for your readers will, I trust, exercise their ingenuity in its examination. I may merely remark, that, although we have ascended occasionally higher than the regions of thunder, we have never arrived at this supposed stratum of gas. The celebrated *Gay Lussac*, who has soared higher than any human being, reached his elevation of 24,000 feet by means of hydrogen gas, loaded, it must be observed, with his own weight, and with that of the balloon, car, and instruments: the gas, rising alone, must necessarily have been higher than the Aëronaut. But the most formidable objection is furnished by the well supported doctrines of Mr. Dalton, who maintains that every gas is a vacuum to every other gas; that, therefore, they become completely diffused through each other; and, consequently, that the formation of a stratum is impossible. This mechanical view of the distribution of the atoms of any gas, will enable us to understand why a considerable quantity may be constantly liberated, and yet never be chemically detected; and why carbonic acid gas, which is produced much more abundantly than hydrogen gas, is perceived in the same proportion, in the higher regions of the atmosphere, in which it occurs near the surface of the earth; where, it will be easily understood, if relative gravity were alone concerned, it ought to be entirely accumulated. With great respect,

I remain, very faithfully your's,
G. Birkbeck.

50, *Broad Street*,
Nov. 20th, 1825.

THEORY OF THE THUNDER STORM.

The usual description of the Thunder Storm does not seem to me to convey a satisfactory solution of any of the phenomena that take place:—the noise of the thunder is said to arise from the disruption of the air from the electric fluid passing from the clouds to the earth; and the rain to be from the change that takes place in the clouds from the loss of electricity. I suspect, however, that there is a much more powerful agent to produce both these effects, and many other phenomena that take place, both at the time, and after the violence of the storm;—and that agent I suppose to be hydrogen gas. In all warm and temperate climates, the decomposition of vegetable and other matters, and even of water itself, is constantly going on, evolving immense quantities of this aërial fluid, which, being so much lighter than atmospheric air, rises through it to a certain height, and, not being soluble in it, there floats (commixed with it,) in immense fields. Vapours, from causes that it is needless to trace here, at length condense into clouds, and these clouds, containing (as I believe is well ascertained), different proportions or quantities of electricity, when coming near to one another, discharge their electric fluid in a condensed stream, from one to another, according to the known laws of electricity; and in the passage from one to the other through this commixed atmosphere of *hydrogen gas* and *common air*, it influences them and they explode with a tremendous noise, giving out, at the same time, a flash of blue light, at the same moment with the bright light of the electric fluid. This, I think, is beautifully exemplified in the experiment of forming water by combining *hydrogen gas* and *oxygen gas* in a small glass globe, by means of the electric spark passed through it; there, a quick eye will first see the electric spark, and immediately after, the whole globe, as if filled with the blue light. Were the thunder the simple disturbance of the air, we should have but one peal with each flash of light, but, instead of this, we have sometimes a continuous roar for nearly a minute, indicating the length of the field of *hydrogen gas* that has been at one and the same time or moment exploded. It is to be observed that no more of the *hydrogen* will be inflamed than there is sufficiency of *oxygen* in that part of the air to combine with it; but immediately after, fresh atmospheric air rushes in and commixes with it, and is then ready to be exploded again upon another condensed current of electricity passing through it from one cloud to another; and thus the storm proceeds till either the *hydrogen gas* or *electricity* is expended: the greatest part of the latter of which, I believe, generally is silently conveyed to the earth by means of the torrents of rain that fall during and after the thunder. The phenomenon of the immense quantities of rain falling so partially and so immediately after the thunder, is easily explained by adverting to the quantity of its component parts (*hydrogen* and *oxygen*) that are combined by the electric stream; for, by far the greater part, if not the whole of the rain, is the immediate consequence of such combination. Another phenomenon may here be attempted to be explained—that of fish being sometimes nearly drowned in their own element after a thunder storm: such an occurrence happened in the Thames last week; a great deal of fish came down the river, and fish of many kinds were seen in great numbers at the surface as if drinking the air; and quantities were caught by means of pails, sieves, and other implements, as described in the London newspapers a day or two after. This phenomenon may be explained by adverting to the manner in which the torrents of rain were formed, and the rapidity with which they fell, not giving time for such a quantity of atmospheric air to be absorbed as would be sufficient for the fish to breathe in, and, consequently, their distress, and the necessity they had to come to the surface; for it is well known that fish cannot live in water deprived of air by means of the air-pump, or in recently distilled water, which latter, thunder-storm rain-water resembles. Other phenomena yet remain to be explained; and first by means of, or in consequence of the sudden conversion of such a vast volume of air into water, a prodigious *vacuum* must, of necessity, be produced, and therefore the air rushes from every quarter to fill it up; hence, the violence of the wind, its variableness, and almost constantly altering with every peal of thunder. The same cause, the rushing in and diffusion of the air in the vacuum, will produce a great degree of cold; hence, the frequency of hail, and even of ice in large pieces during the storm, both in the temperate and in the torrid zones; though the clouds are much below the region of frost. The phenomenon of hail and ice in the torrid zone, during a thunder storm, was experienced in Jamaica a few months ago, as may be seen in the Jamaica papers. The same *vacuum* explains why portions of the sea and of lakes, with their fish, may be taken up into the air or clouds, and scattered over the vallies, or even on the hills, as is said not unfrequently to be the case in the West Indies; and an instance of a salt-water rain occurred in Jamaica a few years ago, which deprived the whole district where it fell of its verdure, (trees included,) for several weeks. The same hypothesis of the *vacuum*, from the explosion and combination of *hydrogen* and *oxygen gas*, without going into particulars, will explain the phenomena of the whirlwind, the hurricane, the tornado, the water-spout, &c., all which have been supposed to depend upon electricity, without its being able to be said in what manner they were produced.

ALEXANDER GORDON.

Oxford Court,
22d September, 1825.

P. S.—The cold produced by the diffusion of the air, may be shewn or illustrated, by filling such a vessel as is used for Mr. David Gordon's portable gas-lamps, with fifteen or twenty atmospheres, and, when cooled down to the temperature of that of the surrounding air, then let out in a stream upon a small vessel of water, it will soon freeze it into ice. This may explain likewise, why condensed steam, when diffused, has no scalding effects, whilst that of common steam acts like boiling water.

The combination of *hydrogen* and *oxygen* into water by the electric spark, seems to be one of the means the Almighty Creator has taken to bring down these elements in the form of rain to refresh the earth; and that they may again enter into the organization of animals and vegetables, for these, together with *carbon* and *lime*, form the greatest share of the organized parts of all animated creation.

A. G.

23d September, 1825.

BATH MECHANICS' INSTITUTION.

(From Keene's Bath Journal, of November 28th.)

On Thursday last the library of the Bath Mechanics' Institution was removed from Walcot-street to No. 14, Union-street, a room more central and commodious; and, in the evening, a gentleman delivered a lecture, introductory to a course on Mechanics, to a very numerous and respectable auditory, consisting of gentlemen, professional gentlemen, master tradesmen, and mechanics; and the continued plaudits which accompanied its delivery, while they shewed a general approbation of the clear elucidations of the Lecturer, distinctly signified the highest approbation of the Institution itself. Having watched the progress of the Institution with peculiar anxiousness for its welfare, the reception of the lecture was peculiarly gratifying to us; and shews that the middling and lower classes of society in this country, are not without friends among the upper orders, who are interested in the promotion of their welfare and happiness.

As great pains have been taken to prejudice the upper classes against the diffusion of knowledge, by means of Mechanics' Institutions, we take great pleasure in publishing the following letter, sent to us by a gentleman who moves in the highest circles in this city; not merely as an acknowledgment of his handsome donation, as that will be made in the quarterly report, but as a proof that all are not influenced by the ridiculous doctrine, that ignorance is essential to the preservation of social order:—

To the Secretary of the Bath Mechanics' Institution.

SIR,—Believing that where natural aptitudes and other circumstances are equal, he will be the best operative mechanic, who best understands the principles of the operations he performs; believing further, that a large portion of the misery which afflicts the world, originates in general ignorance, and, consequently that, for the happiness of mankind, the diffusion of knowledge cannot be too general, I very sincerely wish success to the Bath Mechanics' Institution, and beg to present it with the following books, viz.—

Imison's School of Arts, 2 vols.
Nicolson's Chemical Dictionary, 2 vols.
Chaptal's Chemistry, 3 vols.
Annual Register, 14 vols.

I request also the Institution to accept the inclosed Two Pounds, as a donation. I am, &c. * * *

Lansdown Crescent,
23d Nov. 1825.

MONTROSE MECHANICS' INSTITUTION.

We have been favoured by Dr. GILCHRIST, who, during his recent tour in Scotland, has been indefatigable in his exertions to promote the establishment of Mechanics' Institutions among his countrymen, with a Montrose Journal, from which we extract the following judicious remarks:—

"From the correspondence which has appeared in our columns, and from the opinions which we have gathered of different persons interested in the scheme, we have every reason to believe that a Mechanics' Institution will very soon be established in this town. Our worthy representative in Parliament has, we understand, warmly approved of the measure; and, as he is a patron of such institutions in general, there is little doubt but that he will patronize, in a particular manner, a college for the mechanics of his native place. The Rector of the Academy has come forward, in a public manner, and generously offered his services to the institution; and our Provost, who, by his urbanity of manners, and zeal for the public good, is "buying golden opinions from all sorts of men," is, as we believe, ready to give his support to the measure. From these circumstances, and from a conviction that the establishment will be productive of much good, we look forward with pleasure to the speedy organization of a Mechanics' Institution in the burgh of Montrose.

"Two objections* (and we think only two) can be raised against Mechanics' Institutions, and we state them here for the purpose of answering them. One is, that it signifies nothing to a mechanic who understands his work, whether he learns from the effect or from the cause; and, as learning from the effect is a much readier way, consequently it ought to have the preference. A mason can make a good use of his plumb-line, though he may not know that he is at that time exercising the laws of gravity; and a joiner can form an exact square, without thinking at the time that each corner of the square is a right angle, and that a right angle is an angle of ninety degrees. The other objection is, that many of the great discoveries and inventions have been found out by chance—that the Corinthian brass was discovered after an accidental burning—that the magnetic needle stuck by chance to the iron of a shepherd's sandals—and that the telescope was constructed from the report of two children in Holland, who had looked at a church-steeple through two lenses of glass.

"To these objections, if they may be so called, we have to answer, that, whatever truth there may be in them, they do not militate against a philosophical education—that a knowledge of the cause of any principle in mechanics is by far the best key for improving upon that principle—and that, however fortunate men may have been in stumbling upon important discoveries, it is no inducement to lead the student of nature out of that tract which philosophy has marked out. If we reflect upon the great advantages which have resulted from the dissemination of knowledge among all classes of society in these modern times, we cannot help being delighted, as well as benefitted. Both in a moral and physical point of view, the consequence has been beyond expectation. The steam which, for many ages, rose harmlessly from the pots, and latterly from the kettles, of our progenitors, is now turned, by the hand of philosophy, into the most powerful agent with which we are acquainted. The flame of our coals, which, for many centuries, wasted its beauty in the grate, now supplies the use, and surpasses the brilliancy, of candles and lamps. By the help of philosophy, we can dive into the bottom of the deep, explore the regions of the channel of the sea, or mount up into the air high as the highest of the Andes. Many years were employed, and much labour wasted, in search of the philosopher's stone, which, although never found in the literal sense, may be said to be attained in the improvements which science has made in the arts of life.

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* There is, to be sure, a third objection, which has been recently stated by an Irish doctor; namely, that, as Mechanics' Institutions are patronized by Mr. Brougham, they must of necessity fall to the ground! The admirable reasoning upon which this inference is founded, is too deep for our refutation.

"The practicability of Mechanics' Institutions can now no longer be questioned. They are established all over the country, and they are flourishing in the most successful manner. The Montrose Mechanics' Institution only requires to be begun, and we have no doubt of the advantages of the issue. Many persons of respectability, who have the good of the working classes at heart, are ready to patronize the scheme: —all that is wanting, therefore, is a wish on the part of the mechanics themselves to begin and carry on the institution, without which, the object would be void and the attempt abortive, and wit hwhich it will succeed in the most gratifying manner. Let the mechanics, therefore, signify their opinions to one another—let a public meeting be held for the purpose of making preliminary arrangements—and let the scheme be put in practice without delay. We will readily warrant the success."

PLYMOUTH AND DEVONPORT MECHANICS' INSTITUTIONS.

The Plymouth Journal, after reporting the progress of the Mechanics' Institution in that town, of which there are nearly 500 members, concludes with the following observations on the perceptible improvements that have already taken place in the character of the artisans there:—

"We beg leave to point the attention of those who anticipated insubordination in the conduct of the Mechanics, to the present state of our Dock-yard, to which a great number of the members of the Devonport Institution belong; and it will be found that never were the directions of the officers attended with more cheerfulness and alacrity than they are at present. Knowledge makes the artisan content with his situation, by teaching him that it is an honourable one—that labour is the main-spring of national wealth—that his individual arm has contributed to place his country at the head of all the kingdoms of the earth. What a gratifying consideration! In short, this and the other Institutions in the nation, give fair promise to prove, in good time, that teaching men to think rightly is the true method of checking insubordination and turbulent conduct, and that it is ignorance, or the perversion of knowledge only, that is to be dreaded."

ANDERSON'S INSTITUTION, GLASGOW.

On the evening of Wednesday, the 9th ult., Dr. Ure delivered his introductory lecture to the Mechanics' course, to the largest audience which the hall ever contained, and hundreds were unable to effect an entrance. The subject of the lecture was, the importance of those institutions, which, preceded by Anderson's, had been established for the instruction of the people in science and the arts, and it was delivered with more than his usual eloquence. The lecture was one of the most interesting, containing as it did, the sentiments of one who, for 16 years, laboured alone in the great work; and the manner in which it was received, showed, in glowing colours, the lively interest felt by the audience in such instruction, and their satisfaction at the interesting and eloquent manner in which it was communicated.

The introductory lecture on chemistry, was delivered on the following Saturday evening, and the attendance was, if possible, greater, and the disappointments of admission more numerous, thus showing that the demand for instruction increases with the means for its extension. The style was that perspicuous and clear one which ought always to be studied in popular lectures, and which few know better than Dr. Ure how to attain. The experiments by which it was illustrated, were of the most useful and interesting nature—and the various substances employed in them, with their actions, were explained in the most clear and simple manner, so as to make them understood by all. Various new apparatus have been procured by the Professor, in order, more fully, to illustrate the chemical part of the course; and the arrangement of the subjects to be treated of during the session, are such, we think, as to give good hopes of this being the most interesting course which has been laid before the public for a number of years; and the vigorous exertions which are making to improve and extend the apparatus, already the most considerable in this country, are such as will, we are persuaded, secure solid instruction to the students.

We observe, that electricity and magnetism, with their beautiful and interesting illustrations, are to be treated of early in the session; for which purpose, a new and elegant electrical machine, on the most improved construction, has been prepared, by which many new illustrations will be given.

From the circumstance of the greater part of the shops and warehouses in town, which were formerly open till late in the evening, being now shut at eight o'clock, we anticipate a very large attendance on the Mechanics' Lectures; the inability of the shopmen to attend such, under the old system, being made the ground of their request for a new and more liberal regulation.—*Glasgow Free Press.*

BENEFICIAL EFFECTS OF MECHANICS' INSTITUTIONS.

To the Editor of the Mechanics' Register.

Mr. Editor,—The consideration of few subjects can give more substantial pleasure to the enlightened and liberal philosopher, than that of the rapid progress which the cause of universal education has of late years been making. Not only have schools been established for the elementary education of children and of adults, but we have now Institutions formed for the purpose of communicating scientific and useful instruction to persons whose occupations prevent their devoting much time to those purposes, or to the labouring mechanics of every denomination. The good effects produced by such establishments are already sufficiently apparent to convince their promoters that their labour has not been in vain, and that the pains which they have taken have not been thrown away. An instance has lately come to my knowledge which affords a convincing proof of the beneficial results produced by the establishment of "Mechanics' Institutions."

A labouring man, with whose friends I happen to have some acquaintance, was formerly noted for his dissolute manners, and abandoned profligacy. Though in the weekly receipt of large wages, he was always in distress; and though he had a very large portion of time allowed him for a relaxation from his labour, by no means a painful one, it was always mis-spent, and devoted to the very worst of purposes. His family (a very large one) and himself, were always noted for the want of decency in their apparel, and for irregular conduct: this man, at the suggestion of some friend, joined a Mechanics' Institution, and let us now see him, and what effect this has produced on him. Far from mis-spending his spare time, he employs it in the perusal of some works which will both instruct and amuse him; and in attending lectures which will enable him to improve his business, and make him a useful and virtuous character. It has been frequently and correctly stated, that one fact is of more value than a thousand arguments, and I hope that this will be the case with the instance which I have just noticed.

I am well aware that this amelioration of the condition of working mechanics, and persons in the inferior stations of life, cannot have been effected without the narrow-minded opposition of certain interested individuals, who, conscious of their own idleness and inferiority, are unwilling that those, whose superiors they probably are in condition, should become better acquainted with useful and scientific information than they themselves are. I would ask such a man, Are you a manufacturer? If your men are acquainted with the articles they employ, and their mutual action, will they not produce their compounds of a much better quality, than if they were unacquainted with the nature of the ingredients? Are you the father of a family? will it not be much more to advantage that your sons should be employed in attending the lectures at a Mechanics', or similar, Institution, or in perusing useful and interesting books from their libraries, than in attending those places, and reading those books, which only tend to corrupt and enslave the young mind in their pernicious trammels? The same reasoning will apply to the various classes of objections which may be made to such establishments.

Regarding knowledge as a source of pleasure, the stream of which shall never cease, but continue and increase with amazing rapidity, to the end of time, is it not astonishing that men in general appear to regard the acquisition of it with indifference, and, in some cases, with even perfect apathy? But there shall a time come when they will bitterly repent their culpable obstinacy, in rejecting the acquisition of knowledge when the opportunity was offered them. How many men are there, in the present day, who, when they remember the time when they could have obtained information on certain subjects with facility, and neglected the opportunity, now pass their time in frivolous regret and useless lamentations; never reflecting that there is now a way, and not a single one, but several, open for them; and that "it is never too late to learn!" I am, with much respect, Sir,

Your's, most obediently,

MNEMOPHILES.

SCREW FOR EXPOSED PLACES.

To the Editor of the Mechanics' Register.

SIR,—I beg leave to call the attention of your numerous readers to a screw, which, for the security it offers to all exposed places, deserves a greater share of publicity than has at present fallen to its lot.

Fig. 1

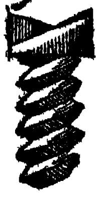
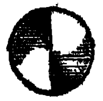


Fig. 2



The above drawings will render its construction easily understood.—Fig. 1. is the screw.—Fig 2. the head of the screw, which is formed by filing one half of it to form an inclined plane, and the other half in the contrary direction. The screw-driver is formed in the same manner. In using, the shoulders will afford a firm resistance to the screw-driver, and it may be screwed into its place with the greatest ease; but when once fixed, it is almost impossible to remove it; for, on turning the screw-driver in the direction for unscrewing, it will slide up the inclined planes and come off, having no action on the screw whatever.

I have shewn this to several mechanics who were quite ignorant of the existence of such an invention. It is part of a patent for securing coffins, granted in the year 1796, and is described in the Repertory of Arts, Vol. X. page 76, first series.

Your's, respectfully,

W. B. jun.

George Yard, Lombard-street.

OUTLINES OF PHRENOLOGY.

DESCRIPTION OF THE ORGANS.

[*Concluded from page* 51.]

26. TIME.—This is a power for noticing the duration or succession of events; it is essential to music. Many kinds possess this power. We know that most men possess it, but in a different degree; the power of judging of the harmony of tunes is not always received by hearing, for some men compose who are both blind and deaf. We find that all great

masters of composition are full above Order.

27. Number.—The special faculty of this organ is calculation in general.—Many examples occur in which persons appear to possess an intuitive power of solving the most complicated arithmetical questions, with astonishing celerity and accuracy. Dr. Sphurzheim is of opinion that arithmetic, logarithms and algebra belong to this organ; geometry seems dependant upon something else, as form and locality.

28. Tune.—To constitute a good musician, a combination of powers is necessary; first, he ought to possess *melody;* then *time*, or the duration of melody. Some persons have a good musical ear, and full of melody or harmony, but yet have the greatest difficulty to play in concert; others, again, play in tune, but are not harmonious. The former will have this organ well developed.

29. Language—There are some persons in whom the eye appears to protrude the lower lid, and such individuals are very fond of *languages*. If we look into their libraries, we find a great number of grammars and dictionaries; they can remember a great number of words and languages; they seize the spirit of language, and are good philologians.

30. Comparison.—By far the greatest number of persons are satisfied with a knowledge of things around them;—while others constantly *compare* them: not satisfied with individual knowledge, they bring it up to a point, and compare the forms and localities of beings.—Those persons who, in conversation, frequently quote examples and analogous cases, are broad in that part of the forehead just above Individuality.

31. Causality.—Comparison is not the highest power; there is one still more important in its effects; it is *causality;* and, here I shall detain you longer.

Some persons, even from infancy, wish to know the cause of every thing, and are continually asking, Why is this, and why that? there are others who never get so high as *why*.—Most metaphysicians have this power, and Gall called it "the power of metaphysics."—Those who wish to account for events, and enquire into the *causes* of things, have the parts adjoining *comparison* broad; comparison in the middle and causality at the side of it; and, we see this organ large in all those persons, who like to dip deep into their profession, whatever it may be, and make themselves acquainted with its principles. If we take Locke, or any man who has, as far as the knowledge of the times has gone, reduced the operations of the mind to principles, such as Milton, Bacon, Watts, &c., we find in all of them the organ of *causality* large. It is infinitely more developed in this country than in any other—there are other operations of the mind which tend to speculation, and if the upper part of the forehead be developed without the lower, then the reasoning will be speculative, because it is not founded on fact.

32. Wit.—Every one feels what wit is, but it is difficult to define it.

Dr. Spurzheim does not consider it an intellectual power, although it may be combined with the intellectual feelings, and receive various names accordingly.

33. Imitation.—We see that some persons have a great talent for imitating others, and are particularly inclined to *take them off*, as it is termed; this is particularly exhibited in children. This organ is situated at the upper part of *Wit*, by the side of Benevolence.

N. B. The organ not marked in the cast, is "Marvellousness," or, as it is called by some others, "Wonder."

Rye. Tyro.

EFFECTS OF NATURAL AND ARTIFICIAL LIGHT ON PLANTS.

The following experiment was recently made by Mr. Henry Phillips, to show the different effects of *natural* and *artificial* light on plants. He selected plants of the *Mimosa Elegans*, *Nova*, and *Decurrens*, whilst their pinnated leaves were fully expanded. On placing them in a dark room the leaves immediately collapsed like the sticks of a fan, or as the feathers of a bird's wing fold over each other. The strongest *artificial light* that could now be thrown on them had no effect on the automatic motion of the plants, and the foliage remained in a collapsed state until they were removed into the natural light of day, when their sensitive properties immediately became perceptible, and the whole of the leaflets were seen moving towards their natural and elegant direction, with as much regularity as a regiment of soldiers file off at the word of command.

EFFECTS OF HOT WATER ON FLOWERS.

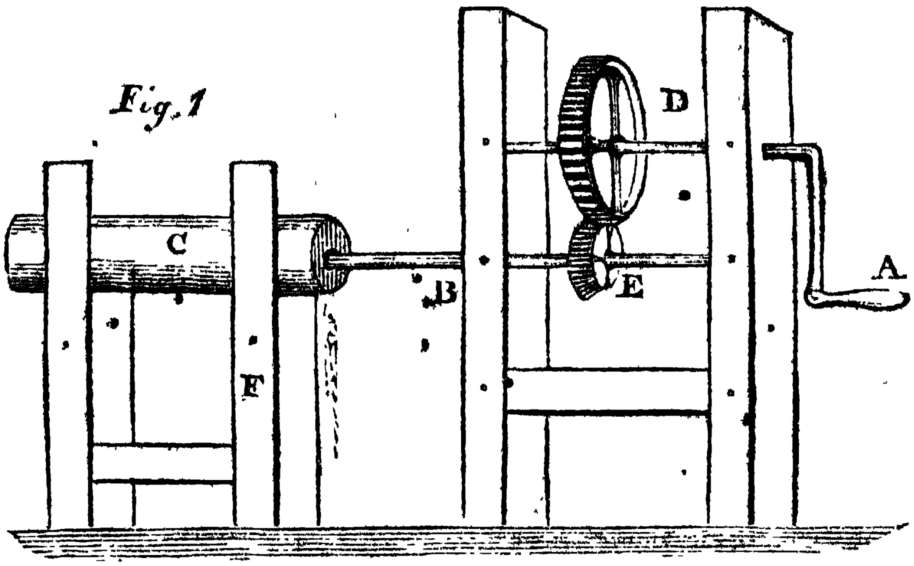
The following fact is deserving of record, as an interesting addition to what has hitherto been discovered on the subject of vegetable physiology, and as enabling the lovers of flowers to prolong for a day the enjoyment of their short-lived beauty. Most flowers begin to fade after being kept 24 hours in water; a few may be revived by substituting fresh water; but all (the most *fugacious*, such as the Poppy, and perhaps one or two others excepted) may be completely restored by the use of *hot water*. For this purpose place the flowers in scalding water, deep enough to cover about one-third of the length of the stem, and by the time the water has become cold, the flowers will have become erect and fresh; then cut off the coddled ends, and put them into cold water.

MACHINE FOR BORING WOODEN PIPES.

To the Editor of the Mechanics' Register.

SIR,—I beg to transmit to you the following diagram of a machine for boring wooden pipes by manual labour, the construction of which I believe to be original:—

Fig. 1



The operation of the machine will be sufficiently evident from the figure and the following references: A the handle, B the centre-bit, C the wooden pipe, D the large cog-wheel, E the lower cog-wheel to which the centre-bit is attached, F the stock for the pipe to rest upon. I am, Sir,

Your obedient servant,
H. W. DEWHURST.

26, Princes Road, Kennington Cross.

CHINESE ALOE.

The Chinese aloe is a large tree, in shape like an olive, which is furnished with three singular barks; the outer one, called *eagle wood*, is black and heavy; the second is brown and very light—it has also the properties of the candle, and when burnt in the fire, has an agreeable smell; the third bark, near the heart of the tree, is used as a cordial in fainting fits, and for perfuming clothes and apartments. This wood is also so precious amongst the Chinese, that jewels are frequently set in it; when incisions are made ein the bark, a cooling liquid flow from it, which, when kept long enough, makes good vinegar; the branches, when eaten, are said to have the flavour of citron; the sharp points which rise upon the branches, are used by the Indians for darts and nails; its leaves serve as a covering for their houses, and, when dried, are shaped into dishes and plates; ropes are made of the roots, and the fibres of the leaves are manufactured into thread.

PATENT SHOT.

A patent has lately been taken out for a new method of making shot. The improvement consists in mixing a small proportion of *quicksilver* with the lead, by which means the shot is rendered harder and heavier, and divested of the arsenic, which was one of the chief objections to the original patent shot. Other advantages are stated to be, that a shot of smaller size is procured for guns of smaller calibre, yet equal to larger drops; that the game killed by it keeps better; that it is as clean as silver to handle, and may be carried loose in the pocket; and it has less friction in firing.

QUERIES.

No. 15.

Suppose a ship going before the wind, and the *same* sail placed first on the top-gallant-mast, and afterwards on the lower mast; would it produce greater effect in one position than the other?

For reasons I decline giving at present, I opine that it would produce the same effect in both cases.

Respectfully your's,
Nottingham, Nov. 1825. F. M.

No. 16.

Can any of your correspondents inform me how to make a cheap Reflecting Telescope, with the length and diameter of the tubes, diameter of the mirrors, form of the lenses, and of what materials they are composed?

L. Rickard.

No. 17.

Sir,—Will any of your intelligent and philosophical readers inform me the cheapest method of constructing a Night Telescope for private amusement and instruction, the expense being so great as to exclude me from the possession of one? If you would insert this in a corner of your valuable miscellany, you will greatly oblige a constant reader, and Member of the Mechanics' Institution. Juvenis W.

No. 18.

Sir,—Should the words *its* and *theirs* be written with or without an apostrophe? Though custom pleads for the omission, I have heard many arguments on the subject.

If Mr. Reynolds, or any other Grammatical Correspondent, will answer this question, through the medium of your work, he will greatly oblige, your obedient servant, R. X.

No. 19.

What is the general force required for the extraction of nails, of all sizes, from the wood into which they have been driven?

A Constant Reader.

No. 20.

Sir,—I shall feel obliged by any of your Correspondents answering the following question.

Will the flame of Coal-gas impregnate Calicoes or Muslins, (which may have been passed through it for the purpose of taking off the fibre,) with any property that will interfere with the brilliancy of the colours used by Calico Printers?

Your's, &c.
J. W.

No. 21.

Will any of your Medical Readers inform me whether playing the flute is injurious to the constitution, and why so?

Clio.

No 22.

How to prepare a good dentifrice, that will preserve the enamel of teeth?

Philo-Dens.

No. 23.

I wish to be informed of the best method of re-laying an Etching Ground, when any part of a copper-plate requires rebiting. I believe one way is to fill up the lines before laying the ground. What is the substance made use of for that purpose? The mode of using it, and the rationale of the process?

A New Subscriber.

No. 24.

Sir,—I shall feel greatly obliged to any of your Correspondents who, through your valuable Register, will inform me, of the best mode of giving a polish to Plaster of Paris casts, such as busts, figures, &c.

A New Subscriber.

ANSWERS TO QUERIES.

Query, No. 12. Vol. III. Page 79.

*** The following letter appeared in the *Mechanics' Magazine* of last week. That we should condescend to pilfer from the pages of that work may appear a remarkable circumstance to our readers, but we have two remarkable reasons to assign for committing this depredation. In the first place, it is very remarkable that the letter should be a reply to a Query which *never appeared* in the Mechanics' Magazine; and, secondly, it still more remarkable, that such a Query actually *did appear* in the Mechanics' Register, signed by *our* Correspondent, W. W.; and at the identical page of the present volume specified in the answer. This very remarkable coincidence* induced us to transfer the communication to our own pages; and leaving our readers to their own reflections on this remarkable subject, we proceed, without further remark, to lay the letter before before them. ED.

SHOOTING STARS ARE SATELLITULÆ, OR LITTLE MOONS.

SIR,—In reply to your Correspondent, W. W.'s concluding query, (Number 12, p. 79,) I beg to state, that an abundant series of observations has satisfied me, that an inconceivable number of solid bodies (small in comparison of any of the known planets, or their satellites, yet of very considerable bulk and weight, some of them) are in continual revolution round our earth, in elliptical orbits; having almost every degree of obliquity to its axis, and of longitudinal and latitudinal places of perigeo, at any assigned epoch: the perigeic portions of these orbits, which lie so near to the earth, as to intersect or dip into its atmosphere, but a small distance, it is, which occasions the phenomena of shooting stars: the resistance and friction which even very attenuated air opposes to the almost inconceivable velocities of these bodies, occasions a heating and a superficial combustion of the masses during their continuance in oxygenous air, and the light evolved thereby reaches our eyes, as a short streak of light, very frequently to be seen, almost whenever the air is quite clear, and the moon and larger planets and stars, are distant from the spot we select to watch attentively.

When the satellitulæ dip deeper into our oxygenous atmosphere than is mentioned above, their apparent courses are longer, and more brilliantly obtrusive on our observation; and when these satellitic bodies dip very deeply into our atmosphere, we no longer call their appearance shooting stars, but *meteors*. These latter, owing to the violent combustion of their surfaces, and nearer proximity, are heard and seen to exfoliate (rather than burst), and the luminous and rough fragments that are scattered, follow the body for a short time, and are denominated *meteoric sparks;* which latter, owing to their very greatly increased resistance against the lower and denser air, fall obliquely to the earth, and are denominated *meteorolites*, or stones fallen from the clouds, but with which last these meteors have nothing to do; they very often traverse a clear sky, and vanish instantly therein, on passing out of our atmosphere.

I remain, Sir,
Your obedient servant,
J. FAREY.

QUERY, No. 12. Vol. III. Page 78.

APPARENT MAGNITUDES OF THE SUN AND MOON IN THE HORIZON, AND IN THE ZENITH.

SIR, — The phenomenon which forms the subject of W. W.'s query has occupied the attention of many learned men, and I believe the general idea is, that the sun appears larger in the horizon than when above it, because, when it is in the horizon, there are intervening objects which make us more aware of its distance, (in the same way as a river appears broader after a side view of the bridge across it); and the apparent magnitude of objects depends on the idea we form of their distance; *i. e.*, if we imagine an object near us, we do not make any allowance in our mind for its distance; and when a body is distant, we do make some allowance. I beg to refer W. W. to Wood's Optics, for more information on this subject. As to the idea of *refraction* magnifying the sun, it will appear that that is not the case, for this reason:—*refraction* only takes place in vertical planes, and could only produce effect on the vertical diameter of the sun.

The only effect refraction has on the sun in the horizon is, I believe, to render its shape *elliptical*, by diminishing the vertical axis; for the refraction varies as the tangent of the zenith distance;* thus it is evident, the lower limb of the sun will be more elevated by refraction than the higher limb; hence, the vertical axis is diminished, while the horizontal axis remains the same; and the figure, instead of circular, becomes oval. The reason the sun and moon appear larger in foggy weather, than at other times, is, that the number of rays incident on the eye, are diminished by the dark medium; and thus, the image on the retina, becoming more faint, gives an idea of greater distance; and this brings the phenomenon under the former case. I am, Sir,

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* This rule only holds true, with accuracy, at considerable altitudes, but it serves to explain the phenomenon of the ellipticity of the sun in the horizon.

Respectfully, your's,
F. M.

Nottingham, November 26, 1825.

APPARENT MAGNITUDES OF THE SUN AND MOON IN THE HORIZON AND IN THE ZENITH.

To the Editor of the Mechanics' Register.

SIR,—In answer to the query of your correspondent W.W., on the apparently increased magnitudes of the sun and moon at their rising and setting, I send you the following extract from Lewis's Catechisms, with a few observations thereon.

"The Moon," says Mr. Lewis, "looks much larger when it is just above the horizon than when it is higher up, because the thickness of the atmosphere, when the moon is near the horizon, renders it less bright than when it is higher up, which leads us to suppose it is farther off in the former case than in the latter, and because we imagine it to be farther from us, we take it to be a larger object than when it is higher up." *Lewis's Catechism of Optics, page* 16, *proposition* 39*th*.—And if this is the cause of the moon appearing so much greater at rising and setting, it will apply, with equal force, to the sun, as I consider both luminaries to appear larger from one and the same cause; but I think W. W. is right in his conjecture, and that it can be ascribed with more satisfaction to a property of the atmosphere to *magnify* the heavenly bodies; and, if my observations be correct, the planets Venus and Jupiter appear of a larger diameter when near the horizon than when considerably above it, and that this is caused by a magnifying power in the atmosphere, I advance the following ideas:—

1. Mr. WALLIS has well observed, that "the astronomer can only reason by *analogy*, and establish his theory on the basis of *inference*," and, judging by analogy, that as transparent glass is known to possess the powers of *refraction*, *reflection*, and *magnifying*, and the atmosphere is acknowledged to possess the two former of these properties, I think there can be no hesitation in inferring it has the third, or magnifying power likewise.

2. Water and all transparent and inelastic fluids are known to possess the three above-mentioned qualities.

3. All substances that are transparent and colourless, and have the property or power to refract and reflect the rays of light, (elastic fluids excepted,) are known to magnify.

4. From these facts I infer that the atmosphere does possess a power to magnify, or that in all substances where refraction and reflection are combined, the magnifying power is inseparable.

5. I have found, by observation, when the *lower part* of the atmosphere is, to a *certain extent*, denser than usual, the sun and moon, at rising and setting, appear larger than usual.

6. I consider it not improbable that the atmosphere acts as a *convex lens*, converging the rays of light proceeding from the heavenly bodies to a focus, which is at or near the eye of the observer.

7. Allowing this to be the case, the atmosphere will possess, at the rising and setting of the heavenly bodies, greater powers to converge the rays of light proceeding from them to a focus, before they reach the observer, and begin to diverge when they strike the eye, and thus magnify the object.

8. From some of the causes here enumerated, or the whole of them combined, or to others I am not acquainted with, I conceive the atmosphere does possess a power to magnify the heavenly bodies, and not that "because we *imagine* them to be farther from us, we take them to be larger objects."

I have to apologize, Sir, for intruding so much on your time; but this paper has far exceeded the length I intended it. I am, Sir,

Your's respectfully,
L. RICKARD.

Walworth, Dec. 1, 1825.

QUERIES, NOS. 7 AND 10, VOL. III. Page 30.

STAINING WOOD — PREPARING PRINTS FOR COLOURING.

MR. EDITOR.—That valuable portion (because so practically useful) of the Mechanics' Register, devoted to Queries and Solutions, I am sorry to find, is fast defeating its object, by the insertion of erroneous solutions, furnished by pretenders whose vanity is gratified by seeing themselves in print, at the risk of the respectability of the work, and to the cost of those who attempt to operate from them. I am led into these considerations by reading the answers to Queries, No. 7, Page 30; and No. 10 same page, by W. B. jun., none of which are capable of producing the required effect. It is a matter of notoriety that, to these little secrets no slight value is attached by the several tradesmen and operatives who possess them; their very bread being often dependent on some superior effect produced by the exclusive possession of some peculiar method, and are not to be so cheaply obtained in the off-hand manner W. B. supplies.

The experience of twenty years has taught me, to my cost, that little or no reliance can be placed in these published treasures. It would be asking too much of an Editor to suppose him intimately versed in the details of every art, and it is cowardly to abuse his confidence.

W. B., junior, has given (I suppose as his own) Instructions to stain black on Wood, which I find in the "Laboratory, or School of Arts, p. 147, published in 1740, at the Looking-glass on London Bridge; and two others from the same work. How modern! Were I inclined to practise a deception on you, this antique volume would enable me to figure away in your work as Solution-Master-General for a century. It is needless to add, that these recipes are rubbish to a workman. I have not leisure to detect W. B.'s source "to prepare prints for colouring," but pledge myself that it is inutile, and woe to him who risks a print on the experiment. The absorption of an acid would have a very injurious effect on many colours, besides not bearing the colours up. I shall be happy, from time to time, to supply a few *working recipes*, such as I can part with, without injury to myself, and tested by practice.

To prepare those prints for colouring which are printed on soft or unsized paper, a little sizing is merely required to harden them; this may be accomplished by boiling a small quantity of picked isinglass in water, till the whole is nearly dissolved; and if, when cold, it sets into a jelly, it is strong enough; this applied warm with a flat camel hair brush, will enable the print, when dry, to sustain either water or oil colours; parchment cuttings (if clean) will do as well as the isinglass.

Should the contents of this be available for your work, I will endeavour another time to point out the many errors so prevalent in these much sought instructions, to the security of sundry practitioners who smile at the impotent attacks of ignorance and pretension.

I am, Sir,
Yours, &c.
GEORGE SOLOMON.

10, *Red Lion-street*,
Clerkenwell.

[We should have been better pleased with the preceding communication, if the writer had exercised a little more liberality in his estimate of the motives which dictated the answers upon which he has animadverted. The vanity of "seeing themselves in print" cannot, we should think, operate very powerfully on the minds of *anonymous* correspondents; and even admitting that W. B. derived his intelligence from the "Laboratory, or School of Arts," we can conceive it very possible that he was influenced solely by a wish to communicate information, from a source which he considered unobjectionable, and which might not be accessible to the generality of readers. We are not acquainted with the work alluded to, but as Mr. S. urges its antiquity as a reason why its authority is not to be depended upon, we would ask him whether, among all the numerous processes in the arts which, by his description, it must contain, there are none which will bear the test of modern experience? As our correspondent has not favoured us with a better recipe for staining wood, than those transmitted by W. B., we presume that this art is one of the incommunicable "little secrets" to which he has adverted. We are, however, obliged to him for the information he has imparted, on the subject of another query, and we insert his letter as the harbinger of a series of answers of real practical utility, and to which no possible objection can be made. —Editor.]

Query, No. 10, Vol. II. Page 30.

STAINING WOOD BLACK.

I think the sub-acetate of iron preferable, as a black stain for beech, &c. to any of those recipes given at page 48, by your Correspondent, W. B. junior. The sub-acetate of iron, or rather the sub-acetate of the protoxide of iron, is made by digesting for two or three days, 2oz. of iron-filings with one pint of vinegar. (No. 24). A little heat facilitates the union.

Your well-wisher,
Left Hand.

5, *Exmouth Street.*

Query, No. 4, Vol. III. Page 13.

DESTRUCTION OF WATER DOCKS AND INSECTS IN GARDENS.

I am no Botanist, Mr. Editor, but as Mr. Dewhurst's queries respecting Water Docks and Insects in his garden remain unanswered, allow me to offer him my ideas on the subject: there are, I believe, three species of this troublesome weed, the *common rhubarb*, the *water dock* which Mr. D. complains of, and the pleasant acid tasting *sorrel;* all agreeing in striking deep into the earth, and being very tenacious of life. A lady once hiring a garden, lamented the number of weeds there were in it, and asked a gardener the most effectual way to get rid of them. "Why Ma'am" said he, "the only way is to dig all the ground twice a day in the summer, and once in the winter."—Now, although I would not recommend Mr. D. quite so much labour, yet I think the only way for him to get rid of his docks is to dig the land well; taking care to throw away every particle of the roots, for they will be sure to strike again, if there is the least bit of earth near them; for my part I should think them a favourable indication, for I never yet saw docks growing on poor land, but in our best land we are terribly troubled with these and *coltsfoot;* after the land is sown we have the dock roots picked off and carried out by cart-loads, where they are thrown into a heap at the side of the road, and grow together in a complete mass.

As for the insects Mr. D. is troubled with, earwigs I should consider very harmless, and when once the cover for them is removed (if I may use the expression) they will disappear; such as the stalks of docks or any vegetable that grows with a hollow stalk. If he is troubled with grubs or slugs, the best remedy I can recommend him is salt strewed over his land; not sparingly, but in pretty good quantities; which besides being highly beneficial to the land, will, I engage to say, completely destroy all these gentry. To convince himself of this, let Mr. D. take a slug and sprinkle him with salt, and he will soon see that not only will the animal be *killed*, but a very considerable portion of him will be *dissolved.* Perhaps it would be worth the enquiry of Chemists, what decomposition here takes place, and what compound is formed.

Your's truly,
A Young Farmer.

PRESERVATION OF YEAST.

Sir,—As there have appeared several communications respecting yeast, perhaps the following method of preserving it during long voyages may not be unacceptable to your readers.—"In making bread at sea, what is chiefly wanted is a substitute for yeast, and which may be formed in the following manner: let a quantity of yeast be spread thin on boards and exposed to a moderate heat, so as to evaporate the humidity, and that it may dry in a granulated state. It must then be put into phials well corked and sealed. Let there next be a strong solution of honey and wort, into which throw a small portion of the powder of yeast, and in the 90th degree of Fahrenheit, a brisk fermentation will soon be excited, perfectly qualified for every purpose for which yeast is employed. The bread made in this manner possesses every advantage of that baked on shore." The above is extracted from a valuable work in my possession, Turnbull's Naval Surgeon, page 31, article Diet, which perhaps, if worth insertion, may find a place in the Mechanics' Register.

I am, Sir, your's &c.
H. W. Dewhurst

26, *Princes Road, Kennington Cross.*

THE LONDON
MECHANICS' REGISTER.

(SUPPLEMENTARY NUMBER.)

> ——————"The charm dissolves apace;
> "And as the morning steals upon the night,
> "Melting the darkness, so their rising senses
> "Begin to chase the ignorant fumes that mantle
> "Their clearer reason."
>
> SHAKSPEARE.

No. 64] SATURDAY, DECEMBER 10, 1825. [Price 3*d*.

CELEBRATION
OF THE
SECOND ANNIVERSARY OF THE ESTABLISHMENT
OF THE
London Mechanics' Institution.

THE SECOND ANNIVERSARY of the Establishment of this excellent Institution, was celebrated by its numerous Members, and their distinguished Patrons, at the Crown and Anchor Tavern, in the Strand, on Friday, the 2d Instant, a day which will be long remembered, with feelings of honest exultation, by every advocate for the dissemination of scientific knowledge amongst the operative artisans of the United Kingdom. Such was the intense interest excited upon this interesting occasion, that though upwards of 600 persons partook of the Anniversary Dinner, many others, who were too late in their applications for tickets, were necessarily dissappointed.

According to the original arrangement, it was intended that the Chair should be taken by the enlightened and indefatigable President of the Institution, Dr. BIRKBECK, for it was impossible that the Stewards or the Committee of Managers, who duly appreciate the obligations which the Members of the Institution, and mankind at large, are under to the worthy President, should think of applying elsewhere for a Chairman. The worthy President, however, voluntarily relinquished his indisputable right to this honourable distinction, and, consulting only the object nearest his heart, the prosperity of the Institution, he communicated to *His Royal Highness the Duke of Sussex*, an intimation that his presence as Chairman, would stamp additional importance on the Anniversary Dinner, and essentially promote the best interests of the society. The promptitude with which the Illustrious Duke complied with this request, is highly honourable to his character, and affords another example of His Royal Highness's anxiety for the welfare of *Mechanics' Institutions*. The Royal Duke attended on the recent City festival, on Lord Mayor's Day, and seeing Dr. BIRKBECK among the distinguished visitors upon that occasion, he advanced towards him, after handing in the Lady Mayoress, and, alluding to the invitation he had received, said,—"*Doctor, I shall certainly preside.*" This kind and condescending declara tion was soon communicated to the Committee and the Stewards, and suitable arrangements were made for the reception of the Royal Visitor at the Anniversary Dinner.

His Royal Highness arrived at the tavern at exactly half-past five o'clock, and was ushered into an ante-room, where he remained for some time in familiar conversation with Dr. Birkbeck, Mr. Brougham, and several other gentlemen.

The dinner being placed on the table, His Royal Highness entered the great room of the tavern, accompanied by Dr. Birkbeck, Mr. Brougham, the Hon. James Abercrombie, Mr. Denman, the Common Serjeant, John Smith, Esq. M. P., Mr. Alderman Wood, Dr. Gilchris, Robert M'William, Esq., Mr. Pettitgrew, His Royal Highness's surgeon, W. Tooke, Esq., Honorary Solicitor to the Institution, Colonel Torrens, Mr. Pollock, Mr. Frend, and other distinguished promoters of intellectual improvement. The entrance of His Royal Highness was hailed with enthusiastic plaudits by the numerous company, and the interest of the scene was heightened by the national tune of "God save the King," played by an excellent band stationed in the gallery.

His Royal Highness having taken the chair, with Dr. Birkbeck on his right, and Mr. Brougham on his left, the company partook of a very excellent and substantial dinner, and the accommodations afforded by the worthy host, Mr. Ottey, appeared to give very general satisfaction.

As soon as the cloth was removed, the Royal CHAIRMAN observed, that the first toast at all great Meetings like the present, was that of loyalty to the King; and in obeying that custom, he proposed "The health of His Majesty, as the Patron of the Arts and Sciences".

This toast was drunk with three times three, and with loud and continued applause.

At this period, many persons who had been unable to procure seats in the great room during the dinner, now entered, and pressed towards the upper end, anxious to obtain even standing room near the principal table, at which the Royal Chairman, Mr. Brougham, and the other leading Speakers, were placed.

The CHAIRMAN said, that as there were a great many gentlemen present, who could not obtain sitting room, he hoped those who had obtained seats would remain seated, and have the urbanity to allow their less fortunate fellow subscribers as much standing room as possible.

The Anthem of "God save the King" was then sung, by Mr. Fitzwilliam, the whole company rising from their seats, and joining in the chorus, in which they were accompanied by the band.

"The Royal Family" was the next toast, which was drunk with the usual honours, and with great applause.

Mr. BROUGHAM then presented himself to the Meeting, and was greeted with the most marked applause. Silence having been obtained, the learned Gentleman proceeded to state, that upon him had devolved the pleasing task of proposing a toast, which could not, according to etiquette, be put from the Chair. They would at once perceive that he meant the Health of the illustrious Prince who did this Institution the high honour, and, if he might take leave to say so, himself the honour also, of presiding at that extraordinary Meeting [loud cheers.] To name the Duke of Sussex, was to praise him; the presence of His Royal Highness, however, restrained him from indulging on a topic which was so fruitful in panegyric. But, he would ask, where was to be found the good work of which he was not the sincere friend? where the enlightened principle of which he was not the zealous and strenuous advocate? They might follow him throughout the whole of his public life, and, in every part of it, they would find him the firm, the undeviating friend of every thing that had for its object the benefit of the people [cheers]. That he was the friend of the people, he had already proved; and if any further illustration of that fact were necessary, they had it in the knowledge that he had ever been the uniform, the enlightened, the zealous supporter of that which tended to advance their best interests—he meant their moral and intellectual improvement [applause]. He had already said, that the presence of the Royal Duke prevented him from saying what he felt due to his character and great public services; but, in truth, he felt that more words were needless, and that, if he went on, he should only be detaining them from paying that tribute of respect and gratitude to His Royal Highness to which he was so fully entitled [applause.] The Learned Gentleman concluded by proposing—"The Health of His Royal Highness the Duke of Sussex, with three times three." It was drunk with loud applause.

The CHAIRMAN rose, and was again greeted with cheering and clapping of hands. After the very kind and handsome manner in which his learned and valued friend had proposed his health, and the warmth and feeling with which the meeting had received the toast, he felt that he must be allowed not merely to return thanks, but also to express the very deep and sincere interest which he felt for the welfare of an Institution, so important, so prosperous, and in favour of which he pledged himself, hand and heart, to make every exertion [loud applause]. Indeed, if such had not been his feeling, they would not have found him present upon that occasion; for he considered the presence of every man in that room as a test of his sentiments in favour of the objects of the Institution, and a pledge to support those objects to the best of his power. The success of the experiment had been beyond all expectation, and every man who was anxious for the diffusion of general education, must feel a proportionate interest in the success of this Institution. It may be considered an additional establishment to their general Schools of Education. Hitherto, they had provided establishments for the education of children, but here was a provision for those who had been deprived of the means of education in their youth, and it was furnished, in the very best manner that it could be furnished,—by the parties themselves [applause]. It had been often stated to the Members, that a great advantage which they possessed, and the possession of which they ought strictly to guard, was, that they provided their own Institution, and they had the management and guidance of it in their own hands [hear, hear!] They might allow, and did right to listen to, the advice and opinions of persons of more knowledge and experience than themselves; but when they came to adopt plans and form laws for their guidance, they were to act upon their own judgments, weighing, of course, the value of the advice and opinions they had received. Another great benefit arising to the members from this, was, that it gave them a double interest in the Institution, and inspired them with a degree of honourable pride, at witnessing the success of their exertions [applause]. As a friend then, as one who felt a deep interest in the success of the Institution, he begged to caution the Members upon one or two points, mainly affecting the interests of the establishment. First, he cautioned them against allowing their proceedings to approach to any thing of a *political* tendency; and, secondly, not to allow any *religious distinctions* or discussions in the Institution [loud applause]. He cautioned them to keep these two great principles in mind, and to act continually upon them. They had a body of laws for their guidance; those laws he advised them to adhere to; and if any alteration should be proposed as advisable, he cautioned them to take time and consider well what they were about before they decided. Again, he wished to caution them against listening to the suggestions of any false friends, and allowing their Institution to be turned into a debating society [hear, hear, hear!]; for they might take his word for it, if any enmity or jealousy existed against them, it would not be openly shewn, but would work its way by secret and underhand means, and that any thing like debating upon political or theological subjects would be at once seized hold of for their destruction as a body [hear, hear!]. He warned them again, to take care and avoid the counsels of false friends, to stick to their laws, and he had no doubt but they would go on with increasing prosperity. There was not any man, entertaining the feelings of an Englishman, who must not feel proud to preserve this extension of useful knowledge and information, who must not rejoice to find that it would render their Sovereign the King of a free and intellectual people, instead of being what they saw in other countries—a ruler over slaves and mere machinery. He wished not to be misunderstood. No man had a greater respect for machinery, and the inventors of it, than he had. It was useful, as it produced economy of time and labour amongst the industrious classes. But here, too, there was an economy of intellect, (if he might so express himself,) as well as time; for, by this Institution, each man was enabled to commune with his fellow member, and give and receive that mutual information and intelligence which was required. He had said thus much, because he was anxious to shew himself a real friend of this Institution. Allied as he was to the Sovereign of an intellectual people, he felt both pride and pleasure in contributing to the advancement of the objects of that Meeting, and he felt convinced that their proceedings would operate as a stimulus to the upper classes of society, and induce them to improve their minds and understandings in proportion [applause]. There were, already established in the kingdom, from eighty-five to ninety such institutions, and he had no doubt that they would increase rapidly, and thereby form a new link between the upper and the working classes of society. That God might prosper their undertakings was his most sincere wish and prayer, and, so far as it was in his power to assist them, he begged to assure them, that they might depend upon his exertions. It might, perhaps, be a bit of a bull, but he would, in conclusion, call upon them to drink their own healths. His Royal Highness then proposed "Success and Prosperity to the London Mechanics' Institution," with three times three [applause].—Air, "Hearts of Oak."

The **Duke of Sussex** then observed, that he now rose to propose the health of a gentleman whose name must be dear not only to every man in that room, but the country at large. A gentleman who had the honour and the pride of being the founder of Mechanics' Institutions in this country [hear, hear!] It was impossible for him to name his esteemed friend Dr. Birkbeck, without at once exciting feelings of respect and admiration for the intellect which could form the idea, and the zeal and ability which could carry into effect the establishment of such Institutions, [applause]. His worthy friend had now the additional pride and gratification of seeing his labours crowned with complete success [cheers.] It happened to few men to have had the fortune to hit upon an idea so advantageous to the public, and many, very many others, had they hit upon it, would have allowed the opportunity to slip them; but Dr. Birkbeck had alike the honour and the good fortune to hit upon the idea, and to see it carried into full and complete effect.—The feelings attending that success must afford a higher satisfaction to the individual than any observations that might come from the Chair, and even than the applause of that room. He had to propose the health of the First Founder of any Mechanics' Institution, Dr. Birkbeck. This toast was received with reiterated and enthusiastic cheers by the Company, who appeared to vie with each other in their expressions of respect and attachment to the worthy Doctor. As soon as the applause had, in some measure, subsided,

Dr. Birkbeck rose, and addressed the crowded assembly, to the following effect:

"The day on which we last met in this place, was distinguished, and will long be memorable, on account of the ceremony of laying the first stone of our commodious theatre; the day on which we are now assembled, is distinguished, and will long be remembered, on account of the presence of one of the most enlightened and benevolent of princes; whose presence, and whose patronage, I am persuaded, will greatly accelerate the progress of the London Mechanics' Institution.

"The intervening period has been marked, as far as regards the intellectual amelioration of the artizan, by events alike gratifying and astonishing. And he who has now the happiness of standing before you, will easily be credited when he declares, that on casting his eye over the recent and the distant past, comparing the first thought, which, in the midst of obscurity, suggested the mental cultivation of the operative mechanic, with the extensive diffusion of the plan to which it has given rise; comparing, likewise, the solitary effort of which it once consisted, with the union of rank, of talent, and of operative power, by which it is now attended, feelings of gratitude and delight are awakened, which no language that I can command, can at all adequately describe.

"The progress of these Institutions, although wonderfully great, has not, however, been without interruption or opposition. At the same time it has happened, most fortunately, that they have been attacked by those whose praise would have been the most severe censure, and whose censure was the highest praise that they could bestow [applause]. From the wise and the good in every direction, we have received the warmest commendation: and as an instance in proof of this assertion, I have the pleasure of stating the opinion of the greatest Mathematician and Philosopher of the age, the celebrated *Marquess De la Place*. In speaking thus of this great man, I appeal with confidence for the support of my opinion, to my distinguished friend Mr. Brougham, himself a profound mathematician, and a very sound philosopher. His praise of these Institutions ought never to be forgotten; and in order that it may be brought accurately before the public, I have prepared several copies of the extract from a letter recently received, which I beg the Gentlemen of the Press attending upon this occasion, to accept and insert entire. This distinguished individual bears testimony to the capability of those for whom these Institutions are designed, to acquire scientific knowledge; and also, that when it falls into such hands or heads, scientific skill is in the most direct road to be usefully applied. (*Hear, hear.)*

"The following are his words:—

'I am much flattered, Sir, by having this opportunity of testifying to you, the high esteem which I entertain for you, on account of the honourable zeal with which you disseminate knowledge amongst the most numerous class of society, and that class which can make at once, the most useful applications of it.' [Hear, and applause.]

"To find an authority so elevated, declaring that Science is in its proper place in these Institutions, must, for ever, put to flight the insignificant objections of a few pitiful sciolists, who, having acquired a little knowledge, maintain that it is something unapproachable by the working classes, and useless when obtained. With regard to the propriety and the justice of our projects for diffusing knowledge, we have the high authority of a noble Lord, holding a very elevated situation in his Majesty's Government, the *Earl of Liverpool.*—That noble Lord has said, in a speech which does him great honour.—'We live in a time when great efforts are making towards the general education of all classes, and all descriptions of men; and God forbid, that any one should suppose that there is any branch of education whatever, from the acquisition of which any class should be excluded, and from the knowledge of which some benefit may not be acquired.

"These are, indeed, powerful admissions in our favour, and I cannot avoid exulting in the strength which they afford.

"It is also most gratifying to contemplate the zeal and ability with which the operatives have availed themselves of the advantages provided by this and other Institutions. By this extensive adoption, I consider our success to be placed beyond all doubt, unless we make some false step. On this head we have received several valuable cautions from our illustrious Chairman, who has also perceived, that nothing but some error in our procedure can prevent the attainment of great and triumphant success. As to the value of science, and of those institutions in promoting its extension, your presence to-day, and your attendance at the lectures of the Institution, so completely evince it, that nothing further need be said. Of the value of knowledge in improving the social, moral, and political relations of man, nothing need, at this day, be offered in proof: I will only declare, with the eloquent Sismondi, 'that man must be enlightened in order to distinguish good from evil; he must be virtuous in order to prefer the former; he must be free in order to make his choice effectual' *(applause).* I cannot conclude without offering my best thanks for the very cordial manner in which my name has been received by this large assembly; and wishing that you may long in health, prosperity, and happiness, enjoy the advantages of the London Mechanics' Institution."

Dr. Birkbeck concluded his eloquent and impressive address amidst loud and long continued acclamations.

The Royal Chairman said, he had next to propose the health of the distinguished individual who sat near him, and he did so with very great pleasure.—If that Gentleman were not present, he might venture to describe the different characters in which he had appeared before the Public; but in nothing had he appeared more eminent or zealous than in his persevering efforts to promote universal education. It was hardly requisite for him to name the individual; because, when universal education was mentioned, all knew that he meant Mr. Brougham. He gave—"The Health of Henry Brougham, Esq., the enlightened and consistent advocate of universal education."—It was honoured with loud applause.

Mr. Brougham rose to return thanks, and was greeted by the meeting in the warmest manner. The meeting, he said, would hardly require him to express his feelings at the kindness with which they had, upon that as well as upon former occasions, done him the honour to receive him. But he hoped they would allow him to trespass upon their attention for a few minutes, while he expressed the pride and pleasure he felt at witnessing the great progress that education was now making in the country. The Learned Gentleman said it was not his intention to enter into minute details, but if fact, illustrative of the increase and prosperity of this institution were wanting, they had only to look to the increase of Members since last year, the number amounting now to 1,900; and to compare the present meeting with the last Anniversary; on that occasion, some two hundred persons were assembled; whereas, now there were present above 600; and he believed, that if the room could have been made to contain two hundred more, they would have attended [cheers]. This spoke volumes; but there was another circumstance which added still an additional volume in proof of the prosperity of such establishments. He told them last year that great institutions did not so forcibly indicate the universal eagerness for the acquisition of knowledge, as those upon a minor scale, and established in small districts. He had now to state, that in a country place, so small as to afford no more than thirty subscribers, there had not long since been established a Library and Mechanics' Institution. This was enough to shew that the system was gaining ground, and must, in a very short time, spread itself all over the face of the country [cheers]. That the system was prosperous in London, and was diffusing knowledge and information most rapidly, was beyond all question; and he grieved to think that there should be found to exist in any quarter, the slightest feeling of jealousy or alarm as to its consequences. But he would, for the present, pass this and all other matters of controversy, expressing only a wish that the opponents of the system would speak and write their objections openly and fully—for then, and then only, could they be openly and fully met [applause]. Let the friends of Mechanics' Institutions hear all the objections of their opponents with candour, with coolness, with respect; and if it was shewn that there was any error in their system, they would gladly correct it. That the system itself was wrong there could be no fear, for what man, with the commonest understanding, could imagine it better to keep his fellow-creatures in ignorance, and resembling, as it were, the beasts of the field, than to give them that education which would at once teach them their value in society, and instruct them in their duty to their Maker? [applause] If any Member of the Institution should meet, either in public or in private, an opponent to this system, he should listen to him with patience and good humour, for surely he might well afford to be good humoured, who felt convinced that he was in the right. Before he concluded, he begged leave to add his humble advice to the wise and wholesome counsel which had been given them by their Illustrious Chairman. Let them, above all things, avoid the dangerous topics of political or theological discussion [Hear, hear!]. These were subjects upon which all men, the very best of men, differed. Every man had a right to an opinion—nay, it was his duty to have an opinion upon both subjects; but he had no right to obtrude those opinions upon his fellow members in that Society. He differed from many of his Friends upon various subjects, but yet he co-operated with them in the support and advancement of different Societies, the principles of which they were alike agreed upon. The Hon. and Learned Gentleman, after a few further observations, concluded by wishing increased prosperity to the London Mechanics' Institution [loud applause].

His Royal Highness then addressed the Meeting, and said the Mechanics' Institution had debts of gratitude, which he was pursuaded the Members would never wish to forget; he was satisfied they would feel great pleasure in testifying the high esteem they entertained of their munificient friend Sir Francis Burdett, who was deprived of the pleasure of attending their Meeting by a fit of the gout. He then gave the health of Sir Francis Burdett, which was drank with immense applause.

His Royal Highness next gave the health of his excellent friend, and the friend of the people, the Hon. James Abercrombie, and the progress of popular Education in Scotland, which was drank with warm applause.

Mr. Abercrombie said, the kindness with which his health has been proposed and received, would, under any circumstances, have excited his gratitude; but coming from a Society, formed for the highly useful and honourable purpose of promoting the education of the people, he felt it a distinction of which he might be justly proud. The most honourable distinction of this enlightened age was the promotion of education. Some, indeed, said we should confine our exertions to the formation of elementary schools; and only teach reading and writing; but reading was only useful as the means of acquiring farther knowledge. It was also alleged, that education would excite false hopes in those who possessed it;—but nothing could be more fallacious, for ignorance and prejudice were the parents of all false conclusions, while knowledge was the best safeguard against error, and most likely to lead to just conclusions, and to produce contentment and happiness. He was confident the best hopes of the friends of human improvement would never be disappointed, while Institutions for the dissemination of knowledge were conducted with the wisdom which had marked all the proceedings of the London Mechanics' Institution. The people of this country were renowned throughout the world for their industry and their courage; he hoped they would be still more highly renowned for their knowledge and their virtue. [Great applause.]

His Royal Highness said the next toast he had to propose was his honourable and excellent Friend, who was known at this side of Temple-bar by the name of Mr. Denman, and on the other side by the title of the Common Serjeant. (A laugh.) But by whatever name or title he was known, he had always the happiness of his fellow men at heart, and was the intrepid defender of innocence, and the advocate of every thing that tended to promote the improvement of mankind.—The toast was drunk with great applause.

Mr. Denman begged to return his best thanks, in his double capacity, for the honour done him, and hoped he should always endeavour to deserve the favourable opinion of the friends of general education. He had been only an observer of their proceedings, but he had witnessed their progress with delight. The Institution, as had been already intimated by its enlightened President, was scarcely less fortunate in its enemies than in its friends.—[Applause]. Its enemies could only argue from its abuse against its use, but they might as well say darkness was better than light, because, on some occasions it might prevent the commission of a crime. They said crime was produced by knowledge, but nothing could be more false. It came within his professional experience, to know that one of the most cunning forgeries that ever came under his observation, was committed by a person who was so grossly ignorant, that he could neither read nor write, and who had yet found means to convert a one guinea note into a ten guinea note.—Guilt was engendered by ignorance, and would always find means for the production of evil. The diffusion of knowledge must lead to good government and the establishment of peace and security. Good government could never be secured but by political liberty, and political liberty could never be maintained but by an educated people.—[Applause.]. It was the object of his warmest hopes that in every town and village in the kingdom, education and peace and freedom might be found united, in this and every other age.—[Immense Applause.]

The Vice-Presidents of the London Mechanics' Institution was the next toast, which was drunk with due honours.

Dr. Gilchrist returned thanks in a humourous speech, in the course of which he observed that Mechanics' Institutions were spreading all over the country, and would amalgamate all classes of society, giving pith to the highest, and polish to the lowest.—[Applause.] Some silly people might think that his Royal Highness should not have come amongst the Members, but such people should know that they were all members of his own family. "Is not the King" continued Doctor Gilchrist, "the *father* of his people? and is not our Illustrious Chairman the King's *Brother*? then, of course, *he is our Uncle*, and certainly we can never have a more affectionate relation." [Loud laughter, in which His Royal Highness very cordially joined.] It was by mingling with the people, that princes obtained a correct knowledge of mankind; Peter the Great worked amongst mechanics, and he civilized his country; Alfred the Great associated with the people, and became the greatest Sovereign that ever England had, excepting, of course, his present Majesty. [Applause and laughter.]

The Auditors of the Institution was the next toast, which was drunk with the usual marks of respect.

Mr. John Smith returned thanks.—He felt great satisfaction, as did his colleagues, in lending their assistance to the Institution. He regarded Mechanics' Institutions with the best hope, as he considered the miseries of mankind the effect of ignorance. He was satisfied the day was approaching when Dr. Birkbeck and Mr. Brougham would be hailed as much greater benefactors of mankind than those who had gained glory by destruction and bloodshed.

Mr. Tooke, the Honorary Solicitor of the Institution, was the next toast.—Mr. Tooke in a neat speech, acknowledged the honour conferred upon him.

His Royal Highness, after handsomely eulogizing the *Committee of*

Managers, proposed their healths, which was drunk with great applause.

Mr. Frend returned thanks on behalf of his colleagues and himself, and, in the course of an excellent speech, traced the progress of useful knowledge from the establishment of Sunday Schools, and Lancasterian Schools, both of which were violently opposed at first, though the latter were subsequently patronized by their opponents, under the name of Bell's, or National Schools. Mechanics' Institutions formed the next step in the progress of education, and he was happy to add, that a further advance was likely to be made, in a short time, by the establishment of a London University.

His Royal Highness next gave, "Alderman Wood, and prosperity to the City of London; and may she ever encourage Science, Freedom, and Commerce"

Alderman Wood, in returning thanks, said, nothing could be dearer to his heart than the prosperity of the people, which would be best promoted by their improvement in knowledge.

It being now half-past nine o'clock. The Duke of Sussex said, the great heat of the room made it necessary for him to retire; he thought it was a pretty good test of an improved constitution, that he had been able to stand the heat so long; he would now leave them, but his heart and his best wishes for their prosperity would remain with them, and if ever his services could promote their objects, which were all good, it would make him happy.—This was followed by immense applause.

His Royal Highness then retired with Mr. Brougham, and some other Gentlemen, when the Chair was taken by Dr. Birkbeck, who proposed the health of Baron Dupin, who had established Mechanics' Lectures in France. The toast was drunk with universal applause.

Mr. Hodgskin then addressed a few observations to the Meeting, on the establishment of Mechanics' Institutions under the sanction of the French Government, and observed that Baron Dupin had paid a just homage to England, by saying that their Institutions were copied from the English.

Dr. Birkbeck proposed "The Press" as the last toast of the Evening, and remarked that all the respectable part of the Press had uniformly supported Mechanics' Institutions.

This toast was received with unanimous approbation, and at 10 o'clock Mr. Birkbeck, with the remainder of the distinguished Visitors, withdrew amidst the acclamations of the company.

EIGHTH QUARTERLY GENERAL MEETING OF THE MEMBERS OF THE LONDON MECHANICS' INSTITUTION.

The Eighth Quarterly General Meeting of the Society was held, at the Theatre of the Institution, on Wednesday evening last, and was numerously attended by the Members.

The new Dial, which Dr. Birkbeck recently informed the Members would shortly be placed in the theatre, had been previously fixed in the front of the gallery, and, punctually, at 8 o'clock, Dr. Gilchrist and Mr. M'William, accompanied by the Committee, entered the Lecture-room, and were welcomed by the cordial greetings of the members.

Dr. Gilchrist, on taking the chair, expressed his regret that, in consequence of the absence of Dr. Birkbeck, who was prevented, by indisposition, from attending, he had been called upon to officiate in his stead. He requested that every Member, who wished to deliver his sentiments, might be heard with patience and attention, and stated that the Secretary would, in the first place, read the Minutes of last Quarterly General Meeting, which would then be put for confirmation.

The Minutes were accordingly read, and confirmed unanimously, after which Mr. Christie, the Secretary, read to the meeting the following comprehensive and satisfactory Report of the Proceedings of the Committee during the last Quarter :—

EIGHTH QUARTERLY REPORT OF THE COMMITTEE OF MANAGERS OF THE LONDON MECHANICS' INSTITUTION.

Whilst preparing to submit to you an account of their proceedings during the last three months, your Committee have been led to take a retrospective view of the Institution during the two years which have elapsed since its formation; and, with feelings of peculiar satisfaction, have witnessed its extraordinary progress.

The rapidity with which the London Mechanics' Institution has attained, its present importance, magnitude, and maturity, is unparalleled in the progress of Literary and Scientific Establishments; and the numerous Institutions or Societies which have, in different parts of the country, followed this example, powerfully proclaim the necessity and obvious utility of such Institutions.

Of the advantages arising from this method of promulgating useful information, and furnishing, at the same time, rational and interesting occupation, none are better qualified to form an opinion than yourselves.

Although many of you have formed a part of, and others are already well acquainted with, the proceedings at the recent celebration of the SECOND ANNIVERSARY which took place at the Crown and Anchor Tavern, yet your Committee may be allowed this opportunity of testifying their gratitude to *His Royal Highness the Duke of Sussex*, and other gentlemen of rank, learning, talent, and influence, who honoured us with their presence and patronage on that interesting occasion.

This circumstance, together with the great number of Members who attended, and participated in the festival, is a most convincing proof how far the Institution has already advanced in public estimation.

Before detailing to you their financial transactions during the past Quarter, your Committee have much pleasure in stating that they have been able to appropriate a considerable portion of the funds to the fitting up of an excellent Laboratory, and thus enlarging materially the utility and resources of the Institution.

General Cash Account.

	£.	s.	d.
Balance in the Banker's hands at the commencement of the Quarter	457	9	0
Paid Bankers during the Quarter	566	16	1
Carried forward..	£1024	5	1
Brought forward	£1024	5	1
Disbursed during the same Period	841	3	0
Leaving a balance at the Banker's, of	183	2	1
In the hands of the Secretary for contingent expenses..	10	0	0
Total	£193	2	1

Of the above sum paid to the Bankers £426 7*s*. 6*d*. have been received in Annual and Half-yearly and Quarterly Payments of Members: — £6 6*s*. 0*d*. from the Co-operative Society for the Use of the Lecture-room:—£18 12*s*. 7*d*. from Pupils in the Elementary Schools for Books, &c. — And £115 10*s*. in Donations.

The items composing the large amount of Disbursements during the Quarter were then minutely detailed in the Report, from which it appeared that between £80 and £90 had been expended in fitting up the Laboratory; nearly £200 in preparing the Library, the School Rooms, &c.; about £140 for expenses attending the completion of the Theatre;—nearly £80 for Apparatus, Models, Transparencies, Tools, &c.;—most of which expenses were of a temporary nature, and such as were not likely to be of frequent occurrence.—The Report then proceeded as follows:—

Your Committee have great pleasure in testifying their grateful acknowledgments to those Gentlemen who have so liberally favoured the Interests of the Institution by their handsome Donations in Money, Books, Minerals, and Apparatus.

Of the £115 10*s*. above alluded to, *Fifty Guineas* have been presented by Messrs. Whitbread, and Co. — *Fifty Guineas* by Messrs. Truman, Hanbury, and Co., both received through the hands of one of your *Vice-Presidents*, John Martineau, Esq., accompanied by *Ten Guineas*, as a second Donation from himself. In addition to the above, your Committee have great pleasure in announcing a Donation of *One Hundred Pounds* received yesterday, from the Rev. Robert Fellowes, of Reigate.

The Committee have peculiar satisfaction in announcing the following splendid List of Books presented to the Library since their last Report;—and as the greater portion of these presents have been from Members themselves, it proves most conclusively, that they are not only aware of the great good to be derived from bringing together the means of acquiring knowledge, but that they are hearty in their co-operations for its accomplishment.

DONATIONS OF BOOKS, &c.

VOLNEY's New Researches in Ancient History 1

(Presented by Mr. John Tapley.)

Hutton's Mathematical and Philosophical Tracts—Dialogue between a Sceptic and a Christian (2 copies). 3

(Presented by a Friend to the Institution.)

Recueil Historique de la vie et des Ouvrages des Plus Célèbres Architectes, 1—Basil Montagu's Thoughts on the Punishment of Death, 1—Addison's Remarks on Italy, 1—Gurney's Short Hand, 1—Voltaire's Letters concerning the English Nation, 1—Topographical Description of the County of Buckingham, 1—Montesquieu's Spirit of Laws, 2—Locke on Government, 1—A Description of Oxfordshire, 1—British Apollo, 1—Jackson's Poems, 1—Addison's Dialogues on Medals, 1—Collection of Poems, by M. Mendez, 1—Monthly Review (for 1803), 2. 16

(Presented by Mr. H. C. Cooper.)

Shakspeare's Dramatic Works, 1—Voyages de Cyrus, 1—A Philosophical Dissertation on the Diving Bell, projected by Mr. Day; by R. D. Falck, 1. 3

(Presented by Mr. W. H. Pitcher.)

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In addition to the above, a pair of 12-inch globes have been received, as the joint gift of Mr. Thompson and Mr. Bacon, a very ingenious instrument for drawing straight and circular lines in all positions, and for laying down angles, together with an excellent brass spiral gunter, have been presented by Mr. Hart.

A small model of a turning-lathe, with different speeds, and two specimens of copper-plate printing in wood, by Mr. William Reid.

A model of a chimney, with apparatus for readily extinguishing fires in the same, by Mr. Collett.

A mercurial thermometer and hygrometer, by Mr. R. Clarke.

A collection of geological specimens, and several valuable minerals, by Captain Wallace; and an eight-day time-piece for the theatre, by Mr. Jas. Gowland.

In conformity to the regulations of the Society. your Committee have how to report, that 677 new members have joined the Institution during the past Quarter; that 332 have ceased to pay their subscription, during the same period; and that the total number of Members, at the close of the Quarter's accounts, was 1887; being an increase of 404 on the number last reported.

In the early part of the Quarter, the Committee were occupied in framing a set of regulations, and making arrangements for the CIRCULATING LIBRARY, and they have now the pleasure of congratulating their constituents on this most important part of the objects contemplated by the founders of the Institution being carried into complete operation.

The arrangement of the LABORATORY and APPARATUS ROOMS, prior to their being opened for the inspection of the Members, has occupied much of their time and attention; and they are now enabled to inform you that the Laboratory will in future be open for the inspection of the Members every Monday, from 12 till 2 o'clock in the afternoon, and from 6 till 9 at night; and that the Apparatus Rooms will be opened every Thursday during the same hours.

Rooms on the basement story have been set apart for EXPERIMENTAL WORK-SHOPS, and the Committee take this opportunity of inviting the Members to come forward, and assist in manufacturing tools for the equipment. A small lathe, and a few turning tools are already produced, which will enable those Members who are disposed to render assistance in furnishing the work-shops to make a beginning, and they will find in the hands of the Secretary a list of the articles principally wanted.

The Quarterly Reports of the Teachers in the ELEMENTARY SCHOOLS are exceedingly favourable. The pupils in the different classes continue to pursue their studies with unabated ardour and with corresponding success.

A class for instruction in *Geometry* and the *Use of the Globes*, has been commenced under the direction of Mr. Reynolds, who has kindly offered his gratuitous services for this purpose.

On the 7th of Nov. Mr. J. Black, jun. was appointed French Teacher to the Institution, with a salary of £30 per Annum—he will commence with a class of 120 of those Members whose names stand first on the list of applicants, who will receive instructions for *three months*, and then be succeeded by another class of the same number in rotation. The class will meet as soon as the large room under the Theatre is furnished with desks and forms.

When this room is completed, which will be in the course of a few weeks, it will be appropriated to the *Drawing Class* as well as the *French*, and thus enable a much greater number of the Members to become acquainted with that important branch of knowledge.

Your Committee cannot conclude without adverting to the interesting and instructive Lectures which have been delivered at the Institution during the Quarter, and testifying their acknowledgments to Mr. Partington for his Lectures on the Steam Engine, to Mr. Cooper for his Chemical Lectures, and to your worthy President, Dr. Birkbeck, or bringing forward and explaining at number of ingenious mechanical, optical and chemical inventions and contrivances in the impressive Lectures which you have listened to with so much satisfaction.

Finally, the Committee beg to express their deep sense of gratitude to the body of Mechanics belonging to this Institution, for the cordiality with which they have entered into and cooperated with all the measures of the Committee of Management, and for their readiness in communicating information, as well as for the cheerful manner in which they have received that which has been communicated to them.

To this unanimity in our proceedings may in a great degree be attributed the present importance, and, upon a continuance of this unanimity must hereafter principally depend the prosperity of the LONDON MECHANICS' INSTITUTION.

The above Report was heard with great attention by the members, and in those parts which related to the extension of the French and Drawing-schools, the opening of the Museum and Laboratory, the preparation of the experimental workshops, the great increase in the number of members, &c. was frequently interrupted by the hearty plaudits of the assembly,

Mr. PETER THOMPSON then moved that the Report be received, which was duly seconded, and the Chairman was about to put the motion, when

MR. C. LANE enquired why the debt of the Institution to the worthy President was not adverted to in the Report? He had heard nothing of it since it was first communicated to the society, and he thought it ought to have formed part of the financial statement.

The CHAIRMAN observed, that the regular mode of proceeding was to receive the Report first, and afterwards to discuss any points which might be suggested by its contents. The Report was then put and unanimously received.

The following letter from JOSHUA WALKER, Esq. M. P., to DR. BIRKBECK, resigning his office as one of the Trustees of the Institution, was then read by the Secretary.

October 1, 1825.

DEAR SIR,

I shall be much obliged by your taking measures to withdraw my name as one of the Trustees of the "London Mechanics' Institution". As soon as it is done, you will perhaps have the goodness to inform me.

I remain, dear SIR,
Your most obedient servant,
JOSHUA WALKER.

To Dr. Birkbeck.

Mr. WALKER's resignation having been accepted, Mr. M'WILLIAM rose and observed, that though the situation of one of the Trustees of the Institution was now vacant, he had the pleasure of congratulating the Members on the circumstance that another gentleman had kindly consented to accept the office, and he had no doubt that when he mentioned his name, the meeting would hear it with acclamations, and unanimously embrace the offer. The gentleman to whom he alluded was the Chief Magistrate of the chief city of England and of the world; and he felt great satisfaction in proposing that the Right Honourable the Lord Mayor of

London be appointed one of the Trustees of this Institution [loud applause].

Mr. Frend seconded this motion, and expressed his sense of the honour conferred on the Institution by the Chief Magistrate, in his ready acceptance of the vacant office. The Members had recently been honoured by the company of His Royal Highness the Duke of Sussex, and they must experience additional pleasure from the offer of the Lord Mayor, which evinced his zeal in forwarding every measure conducive to the interests of "The London Mechanics' Institution."

The motion was received with reiterated plaudits by the Members, and the Chairman energetically declared it to be unanimously carried.

Mr. M'William then stated, that though the multiplicity of Mr. Walker's affairs had induced him to send in his resignation, he felt a deep interest in the welfare of the Institution. He therefore moved a vote of thanks to Joshua Walker, Esq., M. P., for his past services as one of the Trustees. This resolution was duly seconded and carried unanimously.

At a subsequent period of the proceedings, a Member expressed some dissatisfaction at the conciseness of Mr. Walker's letter, which assigned no reason for his resignation, and he intimated his apprehension that the enemies of the Institution might, through the medium of the press, make use of this circumstance to produce an unfavour. impression upon the public mind.

Mr. Frend conceived that, after having passed a vote of thanks to Mr. Walker, it was too much to enter into all the private motives that might have influenced his decision. Sufficient cause had been assigned for that gentleman's resignation, and he thought the meeting could not, with propriety, enter further into the question.

Mr. M'William felt much pleasure in stating, that he was intimate with Mr. Walker, and having often heard him express his gratification at the success of this and all other Institutions of a similar kind, he could take upon himself to assert, that his resignation was not dictated by any disrespectful motive, but by the pressure of his public and private affairs alone.

Mr. Blake thought it was fair to presume, that Mr. Walker was solely influenced by an unwillingness to retain an office, to which his numerous public and private duties prevented him from devoting those *personal* exertions, which were made by his Co-Trustees, Mr. Brougham and Dr. Birkbeck.

Mr. Stacy begged to make one remark on the apprehension which had been expressed, that our enemies might turn this occurrence to our disadvantage. He conceived, that, as long as the Members were unanimous in supporting the Institution, its enemies could do it no injury, and he hoped this observation would allay any apprehensions that had been excited.

The Secretary read the following gratifying communication from Dr. Birkbeck, which, with the exception of that part which alluded to the indisposition of the worthy Doctor, was heard with the greatest satisfaction.

50, Broad-street, Dec. 7.

Dear Sir,—In consequence of falling unwell, from a feverish cold, I have not ventured out of doors to-day, and shall not be able to be present at the Quarterly General Meeting this evening. This being the case, I will thank you to state, what I intended to have done in person, that the Rev. Robert Fellowes, whose liberal donation you have already received, has agreed to establish two prizes of ten pounds each, for five successive years, to be competed for by Members of the London Mechanics' Institution: the one for the best model of any new or improved machine; the other, for the best essay on one of the mechanical powers. The prizes to be adjudged by the President and Professors of the Institution for the time being. Many additional particulars must be afterwards communicated: the final arrangement, however, will require some time for its completion; although I have no doubt that Mr. Fellowes will be glad to see the competition take place very early.

I am, dear Sir,
Very faithfully Your's,
GEORGE BIRKBECK.

Dr. Gilchrist observed, that he participated in the pleasure which this Letter had afforded to the Members, and he would take the opportunity of saying, that Dr. Birkbeck and Mr. Fellowes, were two of the best *fellows* in the world. (*Loud Laughter*),

Mr. C. Lane repeated his inquiry respecting the sum due to Dr. Birkbeck, and asked whether any and what interest had been paid?

The Secretary replied, that the amount was 3,500*l*., upon which no interest had yet been paid, but that arrangements were in progress for paying the interest (4 per cent.), and also for the liquidation of the debt, which would be particularized at the next audit.

The **CHAIRMAN** observed, that in the present prosperous state of their affairs, with nearly 2000 Members, and, consequently, an annual income of nearly 2000*l.* no fears need be entertained of the ability of the Institution to liquidate the debt. If it went on increasing, as it had done of late, he trusted, that by this time next year, the amount would be considerably reduced.

The remainder of the proceedings were of rather a desultory nature, and consisted of various suggestions on the part of the Members, for the benefit of the Institution, and of inquiries connected with its management. Some of these suggestions related to the regulations of the Circulating Library, and others, to the propriety of classifying the Members according to their various trades and professions, the admission of Honorary Members, the augmentation of the Drawing and French Classes, &c. &c.

Thanks were voted to the Rev. Mr. Fellowes, Messrs. Whitbread and Co., Messrs. Truman, Hanbury and Co., and Mr. Martineau for their liberal Donations of Money; to Dr. Birkbeck for his admirable Lectures on various Optical and Mechanical Inventions, and for his exemplary conduct as President of the Institution; to Messrs. Cooper and Partington, for their able Courses of Lectures on Chemistry and the Steam Engine; to the numerous Donors of Books, &c.; to Mr Gowland for the valuable Clock recently fixed in the Theatre; to Mr. M'William, for his constant exertions on behalf of the Institution; to the Committee of Managers for their strict attention to the duties confided to them; and to the Chairman for his spirited, upright, and impartial conduct in the Chair.

DR. GILCHRIST rose to return thanks; and observed that, the more he saw of the conduct of what were called the "Working Classes," the more pleasure and satisfaction he found in keeping company with them, and he considered it a species of blasphemy to apply to them the appellation of the *lower orders*. This was a term that ought never to be used; it was an insult to humanity, and he trusted the expression would be banished from human society. The pride of riches sometimes induced its possessors to trample upon the poor, but nothing could be more contemptible than such conduct; for the poorest man was of as high an order as the highest prince. The pride of literature was frequently displayed in the leading articles of newspapers, in which the terms "*higher orders*," and "*lower orders*," very often occurred. "Perish all such distinctions!" continued the warm-hearted Doctor; "I glory in being in the midst of the labouring classes, and trust that, in a short time, he only will be considered highest, who acquires the greatest portion of useful knowledge, and applies it to the most useful purposes, for the benefit of his fellow creatures." The Chairman concluded, by heartily thanking the Members for their kindness, and assuring them that the Committee would always consider their Constituents as their best instructors.

The Doctor's remarks were received with repeated cheers, and the Meeting adjourned at a few minutes after Ten o'Clock.

MOISTURE IN THE ATMOSPHERE.

To the Editor of the Mechanics' Register.

SIR,—Your correspondent, AMICUS, being aware of my pending experiments, will, doubtless, oblige me with some information which is at present peculiar to himself.

He says, in your 58th Number, "For the same fact occurs when the vessels are placed in a sheltered situation." That I may not leave this important ramification of my experiment unexplored, will AMICUS inform me how I am to shelter the vessels, so that the shelter shall not, by obstructing the wind, accelerate its motion over the bowl, and produce the effect stated by Mr. ASH?

It is unnecessary for me to say much to the explanation given, in the letter I have alluded to, by AMICUS. There is, in philosophical research, a clearness of thought indispensably requisite, with which that gentleman, on certain occasions, from precipitancy, dispenses. His attempt to explain the combustion of steam on *mechanical* principles, may appositely be chosen as an example: the idea which I am about to refute, must have originated in confusion, since it is neither more nor less than that a whole is more than equal to its parts.

That the coalescence of the particles

is, in some degree, effected by reciprocal attraction, none will doubt. That the accidental jumbling together of the drops, augments their bulk and diminishes their number, may be seen as often as it rains. But "At a greater elevation," says your correspondent, "the drops of water are at a greater distance from each other than at a less." This is just the contrary of the truth. For by the principle of attraction which he has stated, and their accidental contact, they must indubitably coalesce; by their coalescence, they must diminish in number; and, by the diminution of their number, their relative distances must inevitably be increased.

Suppose, for an instant, if it be possible, *that at a greater elevation the drops of water are at a greater distance from each other than at a less.* Suppose, also, still agreeing with your correspondent, that this difference is caused by the attraction of aggregation. What confusion presents itself! The drops are farther from each other at a greater elevation than at a less. Whilst they are arriving at a less, their number is diminished by the attraction of *aggregation;* and though, in consequence, there are fewer of them for the same space, they are closer to each other.

To conclude: a whole is not more than equal to its parts. The attraction of aggregation implies merely coalescence produced by attraction, and, consequently, the fewer drops would be received by the lower bowl. The drops attracting each other into union, is entirely foreign to the subject of *quantity.* What matters it whether the bowl receives a whole equal to 4-4ths, or 4-4ths equal to a whole?

A JUVENILE PHILOSOPHER.

What your correspondent calls "*A closer approximation,*" is absolute contact. The expression, "*A nearer contact,*" is a solecism; or, speaking without ceremony, nonsense.

MANUFACTURE OF FLAX.

To the Editor of the Mechanics' Register.

SIR,—As your Register is a medium through which new inventions or discoveries in the Arts, are frequently brought before the public, I beg leave to send you the following communication. It has long been a difficulty with the Manufacturer of *Flax* in this country (say for hosiery) to render it soft for the purpose of manufacturing, but which difficulty, I am informed, has lately been overcome from pure accident. A bale of flax was casually placed under a pipe communicating from the boiler to the condenser of a steam-engine, which pipe was unsound, and, from the continual dropping of the condensed steam upon the above-mentioned bale, that part which was affected, when dry, was found to be perfectly soft; it was also stated, that the person by whom the discovery was made, is so sanguine as to the result, that he has taken out a Patent for preparing Flax for manufacturing purposes, by the simple operation of steeping or soaking it, in condensed steam. I have made further inquiries respecting it, but cannot learn any thing satisfactory; perhaps some of your intelligent correspondents can give me information upon the subject, and if it really is so, where it may be obtained in its prepared state.

Your obedient servant,

J. A.

HORSE CHESNUTS.

IN Turkey these nuts are ground and mixed with provender for horses, particularly for such as are broken winded or troubled with coughs. After being boiled a little to take off the bitterness, bruised and mixed with a small quantity of barley meal, they are a good food for rearing and fattening poultry.

TO CORRESPONDENTS.

"LUTHER" will find, upon application to our Publishers, that his request has been complied with.

The favours of several of our correspondents are inserted this week, but we are obliged to claim the indulgence of many others, whose communications, from the important objects which have necessarily monopolized our attention in preparing the Supplementary Number for the Press, we cannot, at present, particularize.

ERRATUM.

Page 89, column second, line four from the bottom, in part of our impression, for "MULTIPLIES" read "MULTIPLES."

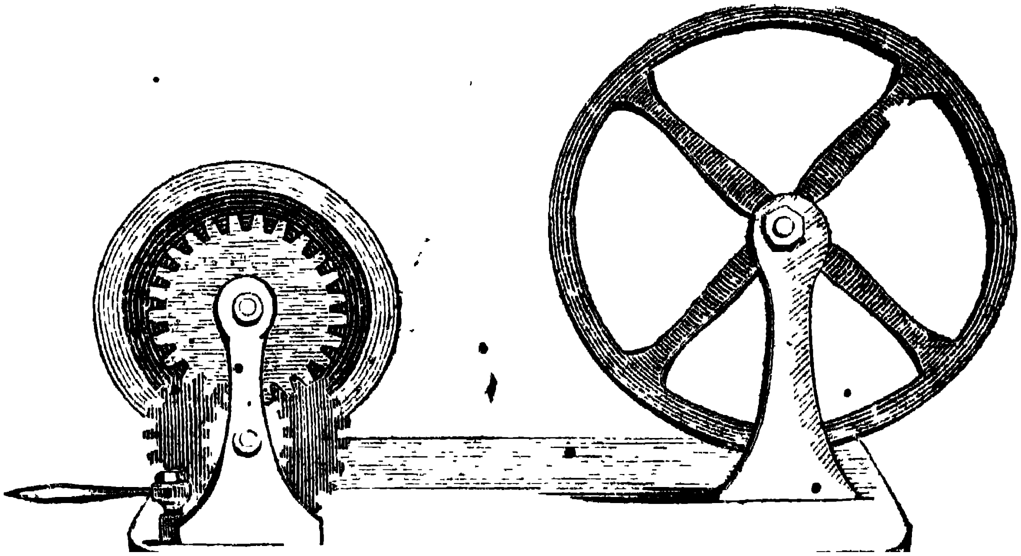
THE LONDON
MECHANICS' REGISTER.

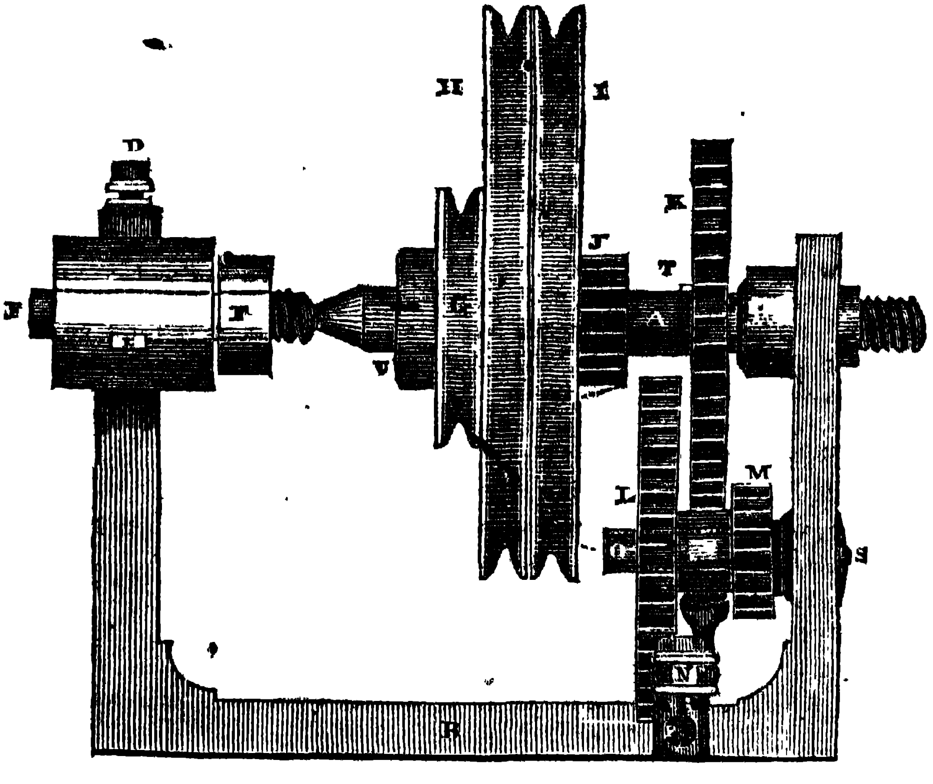
"Experience is by industry atchieved,
And perfected by the swift course of time."

SHAKSPEARE.

No. 65.] SATURDAY, DECEMBER 17, 1825. [Price 3*d*.

MR. REED'S IMPROVED TURNING LATHE.





MR. REED'S
IMPROVED TURNING LATHE.

AMONG the various models and pieces of apparatus presented to the Museum of the London Mechanics' Institution, and particularized in the last Quarterly Report of the Committee of Managers, (vide page 124) was a model of a turning lathe, upon an improved construction, invented by Mr. William Reed, and displaying considerable mechanical ingenuity. We have since had an opportunity of inspecting the model, which is very neatly made of brass, and, in our present Number, we lay before our readers an engraving of the lathe, with a section of the wheels by which its motion is accelerated or retarded, according to the quality of the substance subjected to its operation.

The peculiarity of this lathe consists in its being furnished with two pulleys of the same diameter, which are driven by the same gut, or strap. One of these pulleys revolves four times while the other revolves once, by the intervention of four small wheels, which are thrown in or out of gear, by a lever, as occasion may require

The utility of this arrangement, by the inventor's own experience as an engineer turner, is two-fold. In the first place, a *slow motion* may be produced, for turning steel, or other hard metals; and, secondly, the motion may be rendered *rapid*, and a proportionable increase of power may be gained with very little delay; the band only requiring to be guided to the adjoining groove, whenever a change of speed is requisite. The inventor has a lathe of this kind, which has been in constant use for upwards of five years, and in turning all metals for machinery, he has found it particularly useful, both for dispatch, and for the saving of tools.

REFERENCES TO THE ENGRAVING.

The first figure presents a side view of the lathe, and the second is a section of the wheels, pulleys, &c., on a scale of about 3 inches to the foot. A is the mandril; B, the metal frame, or lathe-head; C, the back cylindric centre, brought up by the nut, F, to a sufficient tightness; E, a steel wedge to retain it after its adjustment; D, an assistant tightning-screw; G, the pulley for wood or light brass turning; H, the common speed for brass or iron; I, the life or loose pulley, when not in gear, with its pinion, J, attached, of 12 teeth or cogs; K, a wheel of 24 teeth, fast on the mandril, A; L, a wheel of 24 teeth, and M, its pinion of 12, fixed together on one bush, and revolving on the gudgeon, O, when in gear; S, the nut for tightning the gudgeon, O; N, the lever for putting the wheels, L and M, in and out of gear (this lever is seen more distinctly in the first figure). When the lathe has the band or strap on the common speed, H, and the slow or powerful motion is required, slip the wheels, L, M, into gear, by moving the lever, N; then guide the band or strap from the pulley, H, to I, and set the lathe in motion. Q is the fulcrum pin which the lever works on; P, the screw; and R, a steady pin, securing Q firm on B. T and U are steel keys, for wedging the wheels upon the mandril, A.

LONDON MECHANICS' INSTITUTION.

MR. COOPER'S
TENTH LECTURE ON CHEMISTRY.

PEARL-ASH—MODE OF MANUFACTURING IT FROM INLAND PLANTS—SEPARATION OF ITS IMPURITIES, WATER, CARBONIC ACID GAS, NEUTRAL SALTS, &c. —PURE, OR CAUSTIC POTASH—ITS MANUFACTURE FROM CARBONATE OF POTASH—FROM CREAM OF TARTAR, NITRE, &c.—DECOMPOSITION OF POTASH BY VOLTAIC ELECTRICITY—POTASSIUM—METHODS OF PROCURING IT—ITS PROPERTIES—COMBUSTION OF POTASSIUM ON THE SURFACE OF WATER, AND IN OXYGEN GAS, &c.

FRIDAY, DECEMBER 9TH.

MR. COOPER commenced the Lecture of the present evening, by stating, that there is a substance imported into England, from Russia and America, in considerable quantities, and which, in the language of commerce, is called *pearl-ash*. This substance is produced by a process which will soon be described, from the ashes of the small twigs of trees felled in those countries. The ashes of all inland plants, when acted upon by water, and reduced to a state of solution, are found to contain alcyli; but it must be remembered, that it is only *inland plants* which produce this substance, for *marine plants* produce another alkaline body, viz., *soda*. When wood-ashes of the former kind are subjected to the action of water, part of their substance is dissolved, while the earthy part of the ashes remains insoluble. Mr. Cooper here poured some water on a quantity of *wood-ashes*, and produced a solution which was necessarily impure, but, by passing it through a filter, he obtained a clear solution, which, by the usual test, was proved to possess a decidedly *alkaline* character.

Now, the mode of preparing this article in the countries where it is manufactured as an article of commerce, is analogous to the experiment just witnessed. The ashes are placed in large butts or vats, and water is poured upon them, which remains till the whole of the soluble matter is mixed with it: to the weak *ley*, thus obtained, more wood-ashes are added, and the process is repeated till the water is nearly saturated. When the solution is in a tolerably concentrated state, it is put into iron vessels, in which it is boiled to dryness, and the residuum is exported to this country in the shape of *pearl-ash*. There is another article called *potash*; brought to this country from America, which is produced in a similar manner, but with the additional agency of *quicklime*. *Pearl-ash* is, in fact, a *carbonate of potash;* and if *lime* be added to a solution of it, the *carbonic acid* of the *pearl-ash* unites with the *lime*, and the ley passes off in the form of a solution of *potash*.

It has been shewn, in speaking of *ammonia*, that *alkaline* substances possess the property of changing the yellow colour of turmeric paper to brown; and as we have seen that this effect is produced by a solution of wood ashes, its alkaline properties are sufficiently obvious. It is used in the process of bleaching, and is also employed by laundresses for the purpose of rendering hard water soft. Mr. Cooper here added a little of the solution of pearl-ash to a glass of common *spring-water*, which immediately assumed a turbid appearance, in consequence of the precipitation of the *lime* it contained, by means of the *carbonic acid* of the *alkali*. It is the *lime* contained in spring-water which causes its hardness, and prevents it from curdling the soap; but the solution of wood ashes gives an additional alkali to that contained in the soap, and by precipitating the lime, softens the water for the purposes of bleaching, as well as for the common operation of washing linen.

If time would permit the evaporation of this solution of wood ashes to dryness, we should obtain a substance precisely similar to the pearl-ash sold in the shops. For the purpose of illustration, we may, however, consider the two substances as identified; the only difference being, that the one is a *solution* of pearl-ash, and the other, the same substance in a *concrete state*. It has been observed, that part of the wood ashes is insoluble in water; but, besides this, there are other impurities in the solution itself, which it is necessary to get rid of. Now *pearl-ash*, or, more properly speaking, *carbonate of potash*, has the property of absorbing moisture from the atmosphere, and it is therefore necessary that purchasers of this article should be careful that they are not purchasing a large quantity of *water*. To discover the presence of this fluid, the *pearl-ash* should be subjected to a dull red heat, by which the *water* will be evaporated, and the loss of weight will indicate the quantity of it contained in the *pearl-ash*, But there are other impurities of still greater importance than the water; and these are the *neutral salts* with which the pearl-ash is contaminated, and to get rid of which, the concrete alkali must undergo solution. As one of the properties of *pearl-ash* is its absorption of moisture, if it be put in a damp place, it will deliquesce, or become moist, and the *neutral salts* will fall to the bottom of the vessel in which it is placed; or a similar effect may be produced by allowing the pearl-ash to remain for a few hours in water.

That it is highly important to purchasers to be enabled to determine the quantity of impurity contained in *pearl-ash* may be inferred from the fact, that the Lecturer had seen in the market, *pearl-ash*, containing only 18 per cent. of *alkali*; while, in other instances, the proportion was as high as 86 per cent. Mr. Cooper here exemplified the mode of detecting the presence of *neutral salts*, by adding an acid to the aqueous solution of wood ashes previously procured

An instant effervescence ensued, and *carbonic acid gas* was evolved in considerable quantities; more *acid* was then added, as it was necessary to pour in a sufficient quantity to neutralize the whole of the *alkali;* and that this effect was produced, was shewn by immersing the discoloured turmeric paper in the fluid, which immediately restored its yellow colour. The two principal impurities by which the quality of *pearl-ash* is deteriorated, are *sulphate* and *muriate of potash,* to discover which, it is necessary to employ certain re-agents, or tests. If the solution of *pearl-ash* contains *muriate of potash,* its presence is detected by the addition of *nitrate of silver;* while the *sulphate of potash* is, in like manner, discovered by employing *barytes* as a re-agent. Mr. Cooper illustrated these remarks by successively adding to the impure solution of pearl-ash before him, the re-agents which he had mentioned, and in both cases, the solution became turbid, and the contaminating substances were precipitated. If a solution of *pearl-ash,* mixed with such impurities, be boiled to dryness, the product is necessarily contaminated in a similar manner; and, as it has been already stated, that the pearl-ash of commerce is sometimes adulterated to the amount of 80 per cent., it is, of course, of essential importance to purchasers of this article, to have the means of detecting its impurities.

In the next place, to convert *carbonate of potash* into *pure,* or *caustic potash,* another process must be adopted; for the *potash* in the market contains so much *sulphur* and *iron,* that it is almost useless for chemical purposes. To produce *potash* in a *caustic state,* recourse must be had to those substances which contain it; and *carbonate of potash* is always employed for this purpose. If this substance be treated with *lime,* and a sufficient quantity of the latter substance is employed to combine with the whole of its *carbonic acid,* it will be found that the solution will refuse to give off any of this gas, upon the addition of either *nitric* or *sulphuric acid.* Mr. Cooper here poured upon some *lime* a solution of *carbonate of potash,* and observed that the lime was now undergoing the process of *slaking.* Those manufacturers who wish to obtain the alkali in a very caustic state (soap-makers for instance), conduct the process in large iron tanks, the bottoms of which are covered, to the thickness of a foot, with straw or old mats, upon which is laid a quantity of *potash,* and over that a stratum of *lime;* a similar arrangement is continued, *stratum super stratum,* till the vessel is filled, when water is poured upon the whole, and allowed to remain for days, weeks, or months, to be drawn off as circumstances may require. By this process, which has just been represented in miniature in the experiment, the *potash* gets rid of its *carbonic acid,* which enters into combination with the *lime,* and the water becomes a solution of *caustic potash.* Mr. Cooper now examined the *carbonate of potash,* which he had subjected to the action of *lime;* and shewed, in the first place, by the immersion of a slip of turmeric paper, that its character, as an *alkali,* was still more strongly manifested. He next observed that he expected, if a sufficient quantity of *lime* had been used, and had remained long enough in contact with the *carbonate of potash,* that no *carbonic acid* remained in the solution. Upon adding an acid, however, a very slight effervescence was observable, indicating that a small quantity of *carbonic acid* had not entered into combination with the *lime.*

But the process thus adopted by manufacturers, will not produce a *perfectly pure solution of potash.* To obtain this substance, therefore, in a perfectly pure, or caustic state, for the nicer purposes of chemical analysis, it is necessary to make it ourselves; for all the *potash* sold in London is contaminated with the *sulphate* or *muriate of potash.* We must, therefore, take *cream of tartar* and *nitre,* in equal parts, and set them on fire; their combustion will produce white ashes, containing perfectly pure *potash.* It is then necessary to procure *lime* in a pure state; and we must, therefore, burn our own lime, which is best obtained from oyster shells or marble; for, as almost all the lime, in general use, is burnt with coals, it is contaminated with *sulphur,* and is, therefore, a *sulphate,* or *sulphuret of lime.* By operating with *pure lime,* on a solution of the ashes of *cream of tartar* and *nitre,* and evaporating the solution to dryness, we shall obtain *crystals of potash,* which must then be dissolved in *alcohol,* and again evaporated to dryness in silver vessels; by which means *potash* will be obtained in a perfectly pure state for chemical purposes.

The alkaline substance, *potash,* must be considered as a *metallic oxide,* compounded of *potassium* and *oxygen.* For this brilliant discovery, we are indebted to the researches of Sir Humphrey Davy, on whose powerful genius, and persevering activity, too much praise cannot be bestowed. He found, by operating *potash* with the galvanic battery, that the *alkali* was decomposed, and that *oxygen* was given off at one of the poles; but as he used a *solution of potash* in the first instance, the effect of the experiment was diminished by the action of the galvanic battery on the *water*, in which the *potash* was dissolved. He afterwards adopted another method, by fusing the *alkali* in a platinum dish, and bringing one pole of a powerful battery in contact with the dish, and the other with the surface of the potash. When the galvanic circle was thus completed, the decomposition of the *alkali* ensued, and was accompanied with extremely beautiful phenomena.

The galvanic battery was now prepared, and Mr. Cooper proceeded to exemplify the manner in which the experiment was performed which led to Sir Humphrey Davy's grand discovery. The poles of the battery being placed in communication with a portion of *potash*, placed in a platinum dish, in the manner described, an immediate chemical action ensued, which, the Lecturer observed, might be perceived by those members who were near the Lecture table. The decomposition of the *alkali* was not, however, so decisive as in the experiment of Sir Humphrey Davy; nor were the attendant phenomena so striking, because the battery employed by that eminent chemist was of much greater power; besides which, the Lecturer had no means of collecting the results of the decomposition. His principal object was to exhibit to the audience the mode in which this splendid experiment was performed by Sir Humphrey Davy, who found that *oxygen* was given off at the *positive* pole of the battery, while the *negative* pole emitted brilliant sparks, which he afterwards ascertained to be *potassium* in a state of combustion. This metallic product was subsequently collected in small globules, under the surface of a fluid, called *naphtha*. The experiment here alluded to is not the mode in which *potassium* is procured for chemical purposes; and the Lecturer's object was merely to exemplify Sir Humphrey Davy's experiment, and to shew that *potash*, like all other substances, is decomposed into its ultimate elements, when exposed to the action of Voltaic Electricity.

Mr. Cooper now proceeded to describe the different processes adopted for the purpose of procuring *potassium* for experimental purposes; and observed, that soon after the discovery of Sir Humphrey Davy, the French chemists, Messrs. Gay Lussac and Thenard, contrived a method of obtaining *potassium* by employing a crooked tube of iron, similar to the one now exhibited. Part of this tube is coated with *clay*, or some other substance which is capable of standing the fire; and this part of the tube, which passes through a furnace, is filled with *iron turnings*. The portion of the tube between the coated part and one of the extremities is filled with *pure potash*, and the iron is then heated, by means of the furnace to the greatest possible intensity. Heat is also applied to the *alkali* till it is fused, and, running down the tube, it becomes decomposed during its passage through the ignited iron. Part of the product of this operation is *potassuretted hydrogen*, which is given off in considerable quantities, while another portion consists of *potassium* in a gaseous state, which is conveyed into a cold vessel, where it is condensed into a *solid*, or *metallic form*.

The construction of the furnace through which the bent tube passes, and of the apparatus connected with it, was exhibited in a diagram; and a second diagram shewed an ingenious modification of the same process, contrived by Dr. Henry, in which the *melted alkali* was made to pass through a small orifice, previous to coming in contact with the heated iron. A third method of procuring *potassium*, by means of a simple retort, was also pointed out; but these processes were of a tedious nature, and would occupy, at least, five or six hours. Mr. Cooper added, that all those processes were very unsatisfactory and uncertain; for they might be tried, perhaps, a dozen times without success, and this was one reason why the price of *potassium* is so extremely high.

Having thus adverted to the different modes of procuring *potassium*, the Lecturer proceeded to speak of the properties of the metal itself; a portion of which, prepared by the decomposition of *potash* by the agency of hot iron, was exhibited in a phial, in which it was confined under the fluid called *naphtha*, for the purpose of preventing the *potassium* from coming in contact with the atmosphere.

Potassium exhibits all the properties of a perfectly metallic substance. When a portion of it is cut through, the divided surfaces exhibit the brilliancy of a metal; but it is so greedy of *oxygen*, that it immediately oxidizes, or becomes tarnished, except it is kept covered with a coating of *naptha*, a substance which contains no *oxygen*. Like other metals, it is malleable, but it is the lightest of all the metallic bodies; its specific gravity, compared with that of water, being as 865 to 1000. Of course, it swims in water and some other fluids, though it sinks in others, of which *naphtha* is one.

This extraordinary metal fuses at a very low temperature; a temperature, in fact, little exceeding that of boiling water. It volatilizes at a red heat, but the vapour may be again condensed into the metallic form by distillation. When thrown upon any fluid containing a considerable quantity of *oxygen*, the fluid is decomposed, in consequence of the great affinity of the metal for the *oxygen* it contains, and the *potassium* becomes inflamed. Mr. Cooper illustrated this remark by repeating the strikingly beautiful experiment of throwing a piece of *potassium* on the surface of water, when it instantly burst into a vivid flame, and floated about as if in search of *oxygen* till, by its union with this constituent of the water, it became converted into *potash*, and communicated its *alkaline* properties to the fluid. In this experiment, the chemical action is so intense, and the condensation of the *oxygen* of the decomposed water, in its change from a gaseous to a solid form, is so great and so instantaneous, that the heat which is generated actually makes the metal red hot, as soon as it touches the water, and the liberated *hydrogen* is instantly inflamed. If we now examine the water contained in the vessel, we shall find that it has acquired a decidedly *alkaline* character. This fact, the Lecturer rendered sufficiently obvious, by immersing in it a piece of turmeric paper, which was instantly changed to a brown colour.

As a further demonstration of the formation of an *alkali*, by the union of *potassium* with the *oxygen* contained in water, Mr. Cooper dropped a small piece of the metal upon a slip of moistened turmeric paper, when the globule instantly rolled about upon the paper in a state of combustion, leaving behind it a distinct brown mark through the whole line of its progress, while the rest of the paper retained its yellow colour.

Mr. Cooper finally demonstrated the powerful affinity of *potassium* for *oxygen*, by igniting a portion of the metal in an atmosphere of the gas. For this purpose, a retort, containing a piece of potassium, was exhausted of air, and filled with oxygen gas over the pneumatic trough. The flame of a spirit lamp was then applied to the retort when the potassium soon became ignited, and burnt with a flame of vivid intensity, till it was completely saturated with oxygen. The retort, as is generally the case in this experiment, was cracked by the intense heat generated during the combination of the two substances, but the result was an orange-coloured compound, which the Lecturer stated to be the *peroxide of potassium*, or that compound which contains the greatest quantity of *oxygen*, whereas the common *potash* is the *protoxide* of the metal.

Mr. Cooper then observed, that, as he had thus far explained the composition of *potash*, and traced the various methods of producing and decomposing it, he should, in his next lecture, give a further illustration of its properties.

LECTURE FOR NEXT WEEK.

Friday, December 23, Mr. Cooper's Twelfth Lecture on Chemistry.

HAMMERSMITH, KENSINGTON, AND CHISWICK MECHANICS' INSTITUTION.

We were unable last week, owing to the press of other important matter, to notice the numerous and highly respectable meeting, which was held on Monday, the 5th inst., at the Latymer School-room, at Hammersmith, for the establishment of a Mechanics' Institution in that district, and its vicinity. The School-room, which is of considerable dimensions, was completely crowded by 7 o'clock, and soon after that hour Dr. BOWLING was unanimously called to the chair.

The CHAIRMAN opened the business of the evening, by stating that the object of the meeting was to found an Institution for the scientific instruction of Mechanics and others, on a plan similar to that adopted by the London Mechanics' Institution. He regretted the unavoidable absence of several gentlemen whose attendance had been anticipated, but he was happy to observe that there was an individual near him (Dr. BIRKBECK) who was well qualified to enforce and illustrate the advantages likely to result from such Institutions, and, therefore, he would not occupy their time in urging the merits of such associations. At the same time, he could not avoid premising, that the maxim of "union constituting strength," which held good in so many other transactions in the world, could not fail to be equally efficacious here; by a union of intellect, by a well planned and well directed exertion of their mental powers, they would have every chance of success.

Mr. MOTE, the Secretary, then read letters of apology from Dr. GILCHRIST, T. CAMPBELL, Esq., S. C. WHITBREAD, Esq., J. C. HOBHOUSE, Esq., M. P., and other gentlemen, who had been invited to attend the meeting. The Report of the Provisional Committee was then read, after which,

Dr. BIRKBECK, amidst loud applause, rose for the purpose of proposing the first resolution, which declared the expediency and importance of institutions for the scientific instruction of Mechanics. He said, it was gratifying to him to have the opportunity of taking part in the formation of an establishment for the advantage of the Mechanics and Artizans of their neighbourhood. Similar Institutions were formed or forming throughout the Empire. What might be the extent, wants, or inclinations of that particular neighbourhood, he had not the means of judging; but of this fact he felt assured, that the diffusion of intellectual light, on the principle of mutual or self-education, created self-respect and confidence, and would sharpen that perspicacity and judgment by which men qualified themselves for the more active exertions and occupations of life. Such improvement was advantageous, whether they looked to the consequences to the individual, or as benefitting society at large. Now there could be no one found bold enough to say, that ignorance was preferable to knowledge, or that it was better that man should be in darkness than in light. It was too late to say, that it would not be beneficial to expand the powers of man by science; it was too late to hold that the circumstances connected with the exigencies of life might not be improved by informing men of the principles of science. If such improvements were calculated to benefit themselves as well as society, was there not sufficient reason to encourage them to devote themselves to scientific enquiries, and to expect that this Institution might flourish as others had done? In such a neighbourhood, where numerous villas were rising, and where a bridge was building, there must necessarily be an immense number of Mechanics and Artizans, whose improvement could not but be attended with the most salutary effects. Where there was so much employment benefit must result, if those had cultivated minds as well as hands to whom the work was delegated. Some acquaintance with the Science of Chemistry, for instance, could not be without its advantage. That Science displayed itself in the art of brick-making, in the preparation of clay, and in the conversion of chalk into lime. Then, again, the composition of mortar was one of great interest; but at present it was imperfectly understood, if the workmen had heads as well as hands. These were matters to which he generally adverted, to shew that an acquaintance with science was calculated to improve the skill of the workman. That advantage to society generally might result from the application of science to mechanical skill, he had only to advert to the instance of Watt, whose wonderful improvements on the steam engine had accomplished a change which had produced the most extraordinary effect on the circumstances of the world. Dr. Birkbeck then introduced a series of appropriate remarks on the honourable competition existing between the manufactories of this and the surrounding countries, and after observing that, to retain the commercial ascendency on which the artizans of this country prided themselves, it was only necessary that they should have minds as well as hands, he adduced the example of the celebrated Arkwright, as a proof of what might be accomplished by mechanics in humble life, and concluded by moving the first Resolution, which was seconed by Mr. Crow, and unanimously carried.

Our limits will only allow us to state, that the rest of the proceedings of the evening were characterized by the same unanimity; the whole of the Resolutions, connected with the formation of the Hammersmith, Kensington, and Chiswick Mechanics' Institution, having been carried without a dissenting voice.

After this business was disposed of, a very excellent Lecture on Astronomy was delivered by Mr. BIRD, of Eton, who had kindly offered his gratuitous services on the occasion. The Lecture afforded universal satisfaction to the meeting, and was loudly applauded throughout.

A ballot will take place on Monday next, the 19th inst., for the election of a President, four Vice-Presidents, a Treasurer, and the other Members of the Committee of Management, at which time all those Members who have paid their Quar-

terly or Annual Subscriptions, will be entitled to vote. Subscriptions and Donations will be received, in the interim, by Mr. J. Gomme, jun.; Treasurer, *pro tem.* near Hammersmith Broadway; Mr. Reed, Bookseller, Hammersmith; Messrs. Baker and Son, Grocers, Kensington; Messrs. Adey and Son, Grocers, Turnham-Green; and by the Secretary, Mr. Mote, No. 1, Lower Mall, Hammersmith.

PETRIFACTIONS.

Few natural curiosities have induced more speculation, or excited more curious research among philosophers than the above phenomena. That beings which were once endued with life and the power of loco-motion, should, after the lapse of years, become converted into an apparently stony mass, defies at first the belief of even credulous minds. Several very ingenious theories have been invented to account for these extraordinary appearances; but the one at present most generally received, and which appears to be nearer the truth than any of the others, does not admit of the identity of the subject under examination.

The nature of the explanation now almost universally admitted, is that the substance called a petrifaction, is not the *original thing itself* changed in any way, but merely a *medallion*, and the formation of which is effected in the following manner. Any substance, take for instance an oyster, having, by some cause which it is not necessary here to mention, become deposited at some depth in the ground, below the reach of ordinary agricultural or other implements, in a peculiar sort of earth necessary for the production of this appearance, in time moulders away and mixes with the surrounding soil. As it is gradually resolved into its primitive and originally component parts, a deposition of fluid, containing in solution, the stony, chalky, or other earth which forms the *petrifaction*, supplies its place, and the fluid particles being removed by evaporation and absorption, in time the whole mass becomes solidified, and according to the nature of the soil, so it is formed either of clay, chalk, &c. assuming the form and size of the original oyster.

Though strictly speaking the word *petrifaction*, as applied to the operation of nature just described, is not perfectly correct, yet as being consonant to general custom, and being more easily understood by the reader than the adoption of new terms, it will be used in the usual sense throughout this brief treatise. The word *fossil* is also frequently applied to the substance under consideration, and it may be used indiscriminately with the former word to avoid tautology.

Organic remains of animals in the petrified form, from the huge and mighty elephant, to the comparatively small rat, have been discovered in various parts of the world. At Kirkdale in Yorkshire, a cavern was explored, containing a vast quantity of the bones of the animals just mentioned, together with those of the hyæna, the wolf and others. Muscles, oysters, and the common bivalves of our seas, are met with in great abundance, as also some varieties of the *nautilus*. The *echenus* or *Sea-hedgehog*, as it is termed, is frequently found in our own country, some varieties of which in a *siliceous*, and others in a chalky state, are in the possession of the writer. In fact, the fossilized remains of great numbers of the animal kingdom, and many of the fishes, and the molusca, are to be procured plentifully in England; but what appears most surprising is, that such vast quantities of the petrified remains of living beings should be discovered in several of our counties, while no such beings are ever met with in the recent state. An inhabitant of the deep called by naturalists the *Cornu Ammonis*, is diffused very generally throughout the earth in certain situations; but it is never found in the living state, with the exception of one very small variety. Some varieties of the *gryphitæ* are also abundantly seen fossilized, but never alive, in any of the seas surrounding us.

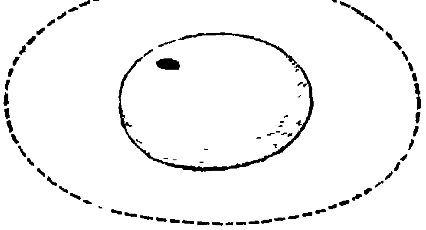
These facts, with others, have been adduced by geologists, as affording presumptive proof of the universal deluge, and its having entirely changed the face of the earth as it originally was formed, and also of having swept away, in its general destruction, the various animals which inhabited its surface, and the several tribes of fishes, and other aquatic tenants of its oceans. In further proof of this argument, immense bones have been found in the state of petrifaction, much larger than belong to any known animal; considerably greater in size than those of the elephant, and which are supposed by many to be the remains of the *mammoth*, which is spoken of briefly in the Mosaic books. An immense *vertebræ*, and one somewhat smaller, are in the collection of the contributor of this article, and which have been decided, as far as human decision can influence such a question, to be without doubt belonging to that unknown and indescribable creature.

Islington. LUTHER.

COURSE OF THE RIVER AMAZON.

To the Editor of the Mechanics' Register.

SIR,—In reply to your correspondent's inquiry in a late Number of the Register, Vol. II. page 366, respecting the reason why the River Amazon rises in its progress (and many other rivers are similarly circumstanced), I would beg to offer an explanation which, perhaps, may be thought satisfactory.



The atmosphere more easily taking the *spheroidical* figure than the earth, its superior pressure on the equatorial parts may counterbalance the want of attraction, and, consequently, the phenomenon exhibited may be produced as per diagram.

JUVENIS.

COURSE OF THE RIVER AMAZON.

To the Editor of the Mechanics' Register.

SIR,—I observe in No. 51 of your publication, a few remarks on the course of the Amazon river, in which the writer wishes to know the reason why the river rises higher than its head; which to me appears to be a natural consequence of the earth's revolution on its axis, by which all fluids are carried from the Poles, where there is no motion, to the equator, where the motion is quickest of all; and hence the cause of the equatorial diameter being longer than the polar.

Your's, &c.

ALSO A MECHANIC.

MOISTURE IN THE ATMOSPHERE.

To the Editor of the Mechanics' Register.

SIR,—As AMICUS has not answered the query respecting the Rain Gauge, I would suggest to your intelligent correspondent, "A Juvenile Philosopher," the *windward* side of such a tower as that now erecting near Waterloo Bridge, as a convenient situation for the two gauges, taking care to place the lowest above surrounding buildings.

I am, SIR, your obedient servant,

17, *George Street, Walworth.* S. E. ASH.

MOISTURE IN THE ATMOSPHERE—COMBUSTION OF STEAM.

To the Editor of the Mechanics' Register.

SIR,—I am not much surprised that "A Juvenile Philosopher" should request some information previously to engaging in the experiment which he talks of, for, undoubtedly, his letter in your last Number, proves him, at present, to be totally unqualified for the task; but, that he should apply to one who "dispenses with the clearness of thought indispensably requisite in philosophical research," and writes what he is pleased to call "nonsense"—does surprise me not a little.

Before entering further into the discussion of the question, you will allow me to make an observation or two, in reply to his attacks, the pertness and arrogance of which, are sadly at variance with the modest and unassuming signature which he adopts. To what cause to attribute the harsh and angry spirit of his letter, I know not, unless it be my exposure of his plagiarism, which, by his letter in your 59th Number, he would fain have us believe, was the offspring of his own precocious genius.

First, as to his question, "How he is to shelter the vessels, so that the shelter shall not, by obstructing the wind, accelerate its motion over the bowl?"—In order to answer a question, it is, I believe, very necessary, first, to understand it, and I have yet to learn how, by *obstructing* a body we *accelerate its motion!* I would beg to observe, that clearness of expression is quite as necessary as "clearness of thought," in philosophical research; and when he puts the question in intelligible language, I shall be happy, if it be in my power, to answer it.

Secondly, as to his "appositely chosen example of my opacity of thought—my attempt (as he says) to explain the *combustion* of steam on *mechanical* principles. I certainly never attempted any explanation of such an absurdity. The effect produced by Mr. Evans's steam furnace, I did, with great humility, attempt to explain on *chemical* principles, and which I should much like to see successfully refuted by some of your scientific readers; and when that has been accomplished, my explanation of the same effect on *mechanical* principles, may, perhaps, not be beneath the notice of "A juvenile Philosopher;"—but let him remember, that on *mechanical* principles, nothing was said of the *combustion* of *steam*.

Thirdly, with respect to the meteorological fact in question, my explanation of which, he is "about to refute," he says, "That the coalescence of the particles is, *in some degree* effected by reciprocal attraction none will doubt." This is all that is required to establish my hypothesis; and unless he can define at what distance that power ceases to exert its influence, his attempted refutation is, in itself, contradictory. The fact is, he does not understand the theory of attraction; he allows its influence on the particles when in a state of vapour, to form drops, and does not allow it in the drops themselves towards each other. I have always been taught to regard it as acting at sensible and insensible distances.

And now, as to the terms "closer approximation" and "nearer contact," which he is pleased, "without ceremony" to pronounce "nonsense;" if I fill a vessel with any substance (no matter what) in a *gaseous* state, are not the particles of that body in contact? If I condense that body to a state of *liquidity*, are not the particles still in contact? If I condense that liquid into a state of *solidity*, are they not still in contact? If I *compress* that solid, as may be done in many substances, *into a less bulk*, are they not still in contact?—Now, if, in all these gradations, the specific gravity be increased in each, how will "A juvenile Philosopher" be pleased to account for it, unless by the "*closer approximation*" of its particles? Until he is able to do so, I would advise him to lay aside his pen, and stick to his books; and when he again imputes to his opponent "nonsense," let him think of the scriptural injunction;—"Pull out the beam that is in thine own eye, then shalt thou see clearly to pull out the mote that is in thy brother's eye."

Your's, &c., AMICUS.

OBSERVATIONS ON ANCIENT HOROLOGICAL INSTRUMENTS; THE GNOMON, CLEPSYDRA, &C.

[*From Mr. Partington's Mechanics' Gallery.*]

THE *gnomon*, which subsequent improvements have converted into a sundial, was probably one of the earliest instruments employed in the measurement of time. Indeed, the progress of a tree's shadow, a phenomenon which must have been open to the observation of all, might have served as a tolerably accurate substitute for that instrument; and it may reasonably be concluded, that the vast altitude of the Egyptian pyramids formed part of a design for representing the wide dominion of the living monarch, by the shadow thrown from his mausoleum when dead.

The *dial of Ahaz* may be adduced as one of the earliest instruments for the measuring of time upon record;* and as king Ahaz lived about seven hundred and fifty years prior to the Christian era, it will be evident that the antiquity of the sun-dial is much greater than that of the water-clock, which certainly belonged to a later period.—The first sun-dial employed at Rome, was placed near the temple of Quirinus, by Papirius Cursor, the Roman general, B. C. 293; before which period, it appears, that they had no mode of calculating the intermediate points of time which occurred in the calendar, but what was furnished by the sun's rising and setting. Soon after this period the sun-dial became a great favourite with the Roman people, and large sums were offered for instruments of this description. But it will be apparent, that however useful the ancient gnomon might have been considered, as a coarse measure of time, it could never have been very generally adopted in those climates, in which the atmosphere did not admit of frequent observation. Accordingly we find that the *clepsydra*, or water-clock, was employed at a very early period; and Vitruvius states, that they were much improved by Ctesibius, of Alexandria.*

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* *Vide* Isaiah, chap. xxxviii. verse 8.

At first the time was indicated in those instruments by the gradual dropping of water from an elevated vessel, or reservoir, to a receiver beneath; and the reservoir being graduated, the empty part shewed the number of hours that had elapsed since it was replenished. It was, however, soon discovered, that the water would not run equably, as a greater quantity must pass out in any given time when the vessel was full, than after it was emptied of a portion of its contents. A reference to the nature of hydrostatic pressure will sufficiently account for this fact, as it is invariably found, that the supply of water from a cistern depends upon the height of the column above the aperture. This irregularity in the dropping presented an obstacle which it required much ingenuity to correct; and although a variety of attempts were made to suit the graduated scale to the efflux, it still remained but a very imperfect instrument. A better acquaintance with the laws of hydrostatics has now, however, suggested a mode of effecting a division of the vessel, which it may be adviseable to apply to this primeval instrument.

It is found that the velocity with which water spouts from the same sized aperture, furnished with a variable reservoir, is as the square root of the height of the surface of the fluid. Thus, if a glass vessel be taken, out of which all the water will flow through an opening, regulated for the purpose, in exactly twelve hours, the whole height must be divided into the square of 12, or 144 equal parts. Of these 11 × 11, or 121, must be measured from the bottom to find the hour of *eleven*; 10 × 10, or 100, from the bottom, will give the division for *ten* o'clock; 9 × 9, or 81, the hour of *nine*; and so on

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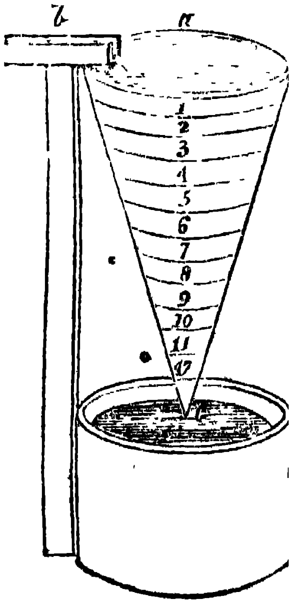
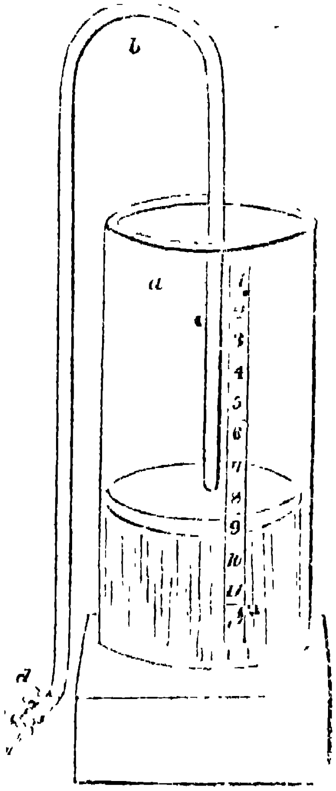
* In the list of those persons who have most benefitted the art of Horology, the name of Ctesibius certainly stands pre-eminent. He lived about 130 years prior to the Christian era, and his father was a barber of Alexandria, in which place this ingenious mechanic was born. He invented the pump and other hydraulic instruments, but the clepsydra may justly be considered as the most important of his inventions. The following accidental circumstance appears to have developed his taste for mechanical pursuits: Upon lowering a mirror in his father's shop, he observed that the counterpoise, which was contained in a cylinder or case, produced a sound, by driving the air before it; and upon examining the phenomenon more strictly, he concluded that he might make an instrument in which sounds should be produced, by the action of water in various sized tubes. The water organ, which he thus constructed, was re-invented by the emperor Nero, and it was a common auxiliary in the most splendid Roman concerts. It is said that a MS. treatise, on the art of dividing and measuring bodies, written by Ctesibius, is still preserved in the library of the Vatican.

continually, taking the square of the hour to be graduated.

We may now, however, examine the construction of two vessels, so constructed as to admit of an equal division for the whole twelve hours, one of which was contrived by Hero, of Alexandria.* The first of these is represented in the following figure, in which *a* represents a conical vessel furnished with an aperture at *c*, a supply of water being introduced every twelve hours by the trough *b*. If the vessel *ac* had been constructed of a cylindrical form, it must be evident that the present mode of graduation would not be adapted to the purpose of an equable division of time; but as the vessel is larger at the first hour than it is at those which succeed, it affords a greater supply to the exit pipe, so that as the fluid descends, the capacity of the vessel diminishes with the velocity of the fluid. We have thus an equable and uniform descent throughout.





Another mode of producing the same effect is shewn in the second figure. The cylindrical vessel *a* is in this case furnished with a float, and syphon *b*, the latter being provided with a stop-cock, *d*, to regulate the flow of the water at *c*. The pressure is in this case always equable, as the syphon invariably remains at the same depth beneath the surface of the water, sinking with the reservoir that supplies it.

(*To be continued.*)

EFFECTS OF CARBONIC ACID GAS ON THE ATMOSPHERE.

To the Editor of the Mechanics' Register.

Mr. Editor.—As you have permitted your columns (No 61, p. 75), to be made the channel of a somewhat scurrilous attack on an article I wrote in them, relative to certain properties of *Carbonic Acid Gas*, in preserving substances with which it combines, by your correspondent, F. C., which I think was uncalled for, I trust you will also allow me, in my own defence, to argue the point a little with him, *in his own peculiar way;* not that I consider this mode as the best for eliciting truth, or benefitting science, but as one that is forced upon me in this instance. Indeed, so little does there appear of the *suaviter in modo* in this gentleman's composition, that no one would ever have suspected him of having, at any period of his life, belonged to a Profession, in which that is usually held to be a requisite, if he himself had not let us into the secret; and as it is, the quantity of bile vomited forth on this occasion is so great, and shews such a diseased state of the system generally, as to make his skill in the *healing art* appear at least equivocal.

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* This universal genius, who flourished in the reign of the emperor Justinian appears to have made considerable progress in almost every branch of mechanics. He was probably the first that applied steam as a prime mover in mechanics; and his water-clocks have been justly considered as master-pieces of ingenuity.

F. C. opens his attack with the following *jeu d'esprit.*—" With your leave (Mr. Editor), I will *dissect* his letter throughout, and if I do not shew it to be a tissue of nonsense, write me down *Ass* for ever." Bravo, Mr. Hector; *nous verrons.*

This assuredly at the commencement, smells a little of the *shop*, and would give earnest, if he was *au fait* at his *trade*, of his cutting the matter up in grand style; never, however, was a *subject* seen so hacked and mangled as this is.

My attributing to Providence, some special purpose, in the general distribution of this gas, to counteract other and opposite effects in the atmosphere, first challenges disapprobation, and sounds to him "somewhat unbecoming." That, Mr. Editor, is very likely, and probably he is to be found of that school of philosophers, that attribute every thing to the doctrine of chances.

He next asserts that "*nature* instructs us in no other mode she has of getting rid of such vast quantities of this (*Carbonic Acid*) gas, than by its decomposition in vegetables." Whilst I have shewn him that it is one of the most generally diffused principles in nature, entering into the composition of almost every substance, &c. He now makes me say, " Carbonic Acid Gas preserves mineral compositions!" and then requests " I will tell him how? and what those compositions are, requiring such preservation?" Now, as respects mineral compositions, that was not strictly my meaning, although I confess the sentence as it stands, may admit of that interpretation; taking it, therefore, in a limited sense, I have no objection that he avail himself of his supposed advantage; and quoting *carbonate of lime* as an example, I enquire what is the effect produced when the carbonic acid gas is driven off from it? do we not see what was before a hard and solid rock, become friable to the touch, and break into powder? and is not this a proof that it owed its preservation in that form (viz. as a rock), to that gas? I will even go further, and say, that though nature instructs F. C. in no other mode of absorption of this gas, but by vegetables, yet will this substance, from which it has been driven off, again speedily absorb it from the atmosphere and resume its former state; on the knowledge of which, most cements are formed,—even that with which our houses are built. Proceeding in his charge, he makes me say, " *Oxygen Gas* is not to be respired unmixed for any length of time," (he should have added *with impunity*) and that further down, I say, " it is not to be respired at all," in answer to which, he says, " *Oxygen Gas* may be respired unmixed, and long without injury, &c." and then proceeds to say, " that breathing this gas pure, has cured many diseases."

The first of these assertions however, rests on his own *dictum*, for he quotes no authority to prove it; and as to the second, it is probable that, taking it in small quantities, it may be beneficial in some disorders, as he professionally may have had an opportunity of knowing; but what of that,—does not he also know, that *Carbonic Acid Gas*, by means of certain media, is so likewise, in scurvy and putrefactive disorders? If *Oxygen Gas* may be breathed pure and long with impunity, I would just ask, why it is, that in making experiments with it on the human frame, it is found advisable to dilute it so highly as 63 per cent. with *nitrogen*, in the form of *Nitrous Oxide*, and when we witness its effects on a person breathing it, even in this state, sometimes requiring four men to hold him down in his chair, to prevent his committing violence? If F. C. discovers so much irritability in merely discussing the subject, we may easily conceive what effect breathing the pure material would have on that unfortunate gentleman.

On looking into Murray, I find he says, "If an animal be confined in *Oxygen Gas*, its respiration becomes hurried and laborious, and it dies, even though so much *Oxygen* is present, that another animal of the same species, introduced into the residual air, will live." And in another place, speaking of *Nitrous Oxide*, he says, "The large warm-blooded animals confined in it, die generally in five or six minutes; the smaller, in one or two minutes." So much for that part of the subject.

In the next article, F. C. gives us as fine a specimen of *mock pathos*, and *beau ideal* in composition, as ever was penned, and which it would be a pity not to give entire—taking fire at the supposition that brick and lime kilns, in large cities, has an effect in counteracting the humidity of the atmosphere, and that, without this, in our moist climate, they would scarcely be habitable, he exclaims "Ah! you naughty officers that took up men the other night, and called them vagabonds (see the Times paper) because they dared to sleep near a limekiln: could you not, dull of apprehension, perceive these were but poor philosophers offering up their adoration at the shrine of their favourite, the god of their idolatry, the philosopher's stone! the prolonger of life! the renovator of cities! without whose vital breath we could not exist! And vile sacrilegious wretches; how dared ye remove, a few days prior, another of these self-devoted philosophers, from the temple that he loved; true, he was dead to us, in a worldly sense, but like other possessors of the secret of the philosopher's stone, he was immortal in reality, never dying! lying in his glory, mixing his carbon with, from, off, or out of the altar, and wandering to renovate towns, cities, and the world at large!" toll de roll, loll! what a beautiful illustration have we not here of Pope's celebrated lines in his Essay on Criticism:—

"Some have at first for wits, then poets past;
"Turn'd critics next, and proved plain fools at last.
"Some neither can for wits nor critics pass,
"As heavy mules are neither horse nor ass."

If the object of all this was to shew that breathing *Carbonic Acid Gas* unmixed, would prove fatal, what necessity was there for that which was conceded at the outset? All I contended for, was, its great *antiseptic* qualities, its universal diffusion in nature, and its consequent utility, as opposed to *Oxygen*, the great *Acidifying and Corroding* principle in promoting the decomposition of substances. When told that this latter is constantly at work in close and confined places, he demands "where such places are to be found?" If F. C. means by this, his "*Pure Oxygen*," I say nowhere; as its volatility is such, that when set at liberty, it immediately seizes on some object within its reach, or escapes into the atmosphere. But if he is desirous of seeing it actively at work, he has only to go wherever decomposition is going forward, and follow his nose into any of the common sewers about town. *Carbonic Acid Gas* differs from *Oxygen*, in that its specific gravity being greater than that of the atmosphere, it will lie unmixed (if not agitated and dispersed) on the surface of the ground where it is generated, as on lime-kilns; and any person having the imprudence to place his head on the ground, within its atmosphere, will assuredly be suffocated. Alluding to some remarks I made on *Fermentation*, he says, "I do not profess very correctly to remember the theory of it, but I know that *Carbonic Acid Gas* is generated, and I know that *Acetous Acid* is generated, and I am also confident, that sour wine was never yet cured by *Carbonic Acid*, but I know it has by adding *Carbonate of Soda*, the soda entering into combination with the super-abundant *Acetous Acid*, and evolving the *Carbonic Acid Gas*, with which it was previously combined."

In this, it is really difficult to pronounce which to admire most, his modesty in allowing his ignorance, or his presumption, after such declaration, in asserting that of which he is positive.

If he has ever heard of the process, as he says, he must know that in Germany, where it was first discovered, the only process used, was either by adding *Charcoal* to the wine, or putting the wine into a cask, the interior of which was *charred*; for *Carbon* having a greater affinity for *Oxygen*, than

Oxygen has for almost any other substance, excepting the *alkalis* and *metals*, will speedily seize upon it from the *Acetous*, to form *Carbonic Acid Gas*, and restore the liquor. That *Carbonate of Soda* will produce a similar effect, I am willing to allow, but a new substance, *Acetate of Soda*, being formed in the wine, which it did not before contain, quere, whether its flavour and quality would not be altered by it?

I may here add, that such are the preservative properties of *Carbon*, that water put into casks that have been charred inside, it is found will keep good in any climate, and for any length of time; and fresh meat, wrapt in cloth well dusted with powdered charcoal, and excluded from the air, may be kept sound in like manner.

Having now refuted all that is material in the observations of F. C., I will leave it to your readers to judge which of us has most occasion to go to school; and whether he has not now fully established his claim to the title he promised himself at the commencement. Of this, however, let me assure him, that he may prick up his long ears and, delighted, bray as loud, as deep, and as long, in future, as he pleases, without attracting further the attention of—Mr. Editor,

Your obedient servant,

GMO. HENRICUS.

[GMO. HENRICUS has certainly some grounds for imputing a want of courteousness to his opponent, and we have, therefore, as an act of justice to G. H., allowed him to retort in a style somewhat similar to that of F. C. We must, however, candidly confess that we have inserted both the communications in question with some reluctance, for we perfectly agree in opinion with G. H., that this is "not the best mode for eliciting truth, or benefitting science." We are unwilling to put any unnecessary restraint on the arguments of our correspondents, but we must intreat them to bear in mind, that the *suaviter in modo* is not less essential than the *fortiter in re*, and that, in all scientific discussions they should studiously endeavour to convince the judgment, without wounding the feelings, of their opponents. We hope these remarks will be received by the two gentlemen whose communications have occasioned them, with the same spirit of conciliation which has dictated them, and that the hint will also be taken by some others of our correspondents, who have occasionally, in the warmth of argument, stepped a little beyond the bounds of dispassionate discussion.—ED.]

ANSWERS TO QUERIES.

QUERIES, Vol. II. Page 304.

GASES GENERATED BY VEGETABLES.

I shall answer your correspondent ELECTRIC, in a different manner from F.C. (page 15 of the present volume). To the second part of his first Query, I answer; vegetables during their growth *consume the oxygen* of the air, and *form carbonic acid* in a quantity proportionate to the *oxygen consumed;* and this takes place, not only in the dark, but in open daylight, except they be under the direct influence of the sun, when the reverse is established.

His second Query "he has *not* in the note to his communication in a great measure answered himself;" for vegetables do not "repose during the night," and they do not, "during the day," give out *oxygen* enough "to improve our atmosphere considerably; because many plants grow without being exposed to the solar rays, and at certain seasons the degree of exposure is very inconsiderable, when compared to the seclusion. In winter, when nearly all the functions of plants are stopped, how is the *carbonic acid gas* consumed?

It will not be necessary to answer the third Query, for what I have already said will explain it:—that under the exposure of solar rays, vegetables decompose *carbonic acid gas* and form *oxygen*; but when excluded from them, even though there may be *light* present, they consume *oxygen* and form *carbonic acid*.—Indeed, vegetables, when confined in *carbonic acid*, die, while they live and flourish in oxygen.

The next person who wields the "grey goose quill" on this subject, is GMO. HENRICUS. (vide page 62.) In the first paragraph, he makes a mistake in stating, there is one per cent of *fixed air* in the atmosphere; there is only a thousandth part. In another part of the same, he says, *oxygen* is not "to be respired for any length of time without producing, ultimately, the same fatal effects as the other (*carbonic acid*); and in the second, he says, "*oxygen*, or rather nitrous oxide, for it cannot be respired pure." Now *oxygen* not only can be respired a long time, but it supports animal life in a more eminent degree than *common air*; a bird being confined in it lives four or five times as long as it would in the same quantity of atmospheric air. Air in which there is *excess of oxygen*, increases the circulation of blood, and gives to the human frame all the marks of a more intense vitality; and it is likely life may be rather shorter, but more pleasant, in proportion to the excitement: while, on the contrary, air in which there is a *deficiency*, as in cities and apartments, in which persons have breathed, or combustible matters have been burnt, is injurious; and it is found to cause those who breathe it to become "dull, languid, and weary, as if the springs of life were drying up."

Animals cannot be confined in ill ventilated apartments with impunity. Horses will become infected with the *glanders*, and fowls with the *pip*. This occurs in like manner in the vegetable kingdom; and the unhealthy appearance of vegetables in crowded cities is a very good proof. The following extract from *Evelyn*, will be most likely interesting to your readers: "That the smoke destroys our vegetation is shewn by that which was by many observed in the year 1644, when Newcastle was besieged, and blocked up in our late wars, so as thro' dearth and scarcity of coals, these famous works were either left off or diminished; divers gardens and orchards planted even in the very heart of London, (as in particular, my Lord Marquis of Hertford in the Strand; my Lord Bridgewater's, and some others about Barbican) were observed to bear such plentiful and infinite quantities of fruits, as they never produced before or since, to their great astonishment, but it was by the owners rightly imputed to the penury of coals, and the little smoke which they took notice to infest them that year."

I should be obliged to him to explain the passage beginning with "It may be asked," for it is very unintelligible, or I am very stupid. He offers to shew how *excess of oxygen* is engendered in the atmosphere, and then tells us it is principally *by moisture decomposing animal substances, and producing sulphuretted hydrogen and other deleterious gases.* I am sure your readers ought to be obliged to him for his "new and important view of the subject!" a subject which only exists in his imagination, *oxygen* being invariably in the same proportion in the atmosphere.

After having noticed *fermentation*, he says, "Here (which does he mean, the *acetous* or *vinous* fermentation?) I think there can be little doubt that the *oxygen*, as well as the *caloric*, are supplied from the moisture." Now, if he means the *vinous* fermentation, no *oxygen* is absorbed—the atmospheric air not being essential to the process; although the liquor when shut up does not so readily ferment; this, however, depends on the accumulation of *carbonic acid gas*: nor is any water decomposed during the process; it is the *sugar* alone furnishes the two new products, the *alcohol* and the *carbonic acid gas*; part of the *carbon* unites with the *oxygen* of the sugar, and forms *carbonic acid*; and the remaining *carbon* combines with the *hydrogen* of the sugar to compose alcohol.

But if he meant the *acetous* fermentation, it is the *oxygen* of the air which is consumed, and therefore, the access of the atmosphere is indispensable; little or no *carbonic acid* is evolved. I beg leave to subscribe myself,

Your much obliged
And sincere well-wisher,
Rye. TYRO.

TO CORRESPONDENTS.

We were unable to get the diagram engraved in time for the insertion of N. R.'s communication in the present Number.—We are obliged to him for his friendly suggestions, which very nearly coincide with our own views.

Mr. B. WILLS has our best wishes for the success of his plan for the encouragement of Industry; but the insertion of the prospectus he has transmitted to us, might lead to discussions of a political nature, which we are anxious to avoid.

As our object is rather to instruct than to puzzle our readers, we must decline inserting the Geographical Riddles of EYLNU ENON.

Communications have been received from W. MELLOR—G. J.—FOX—LOUISA M. H.—W. W.—W. YOD. T.—and several other Correspondents.

ERRATA.

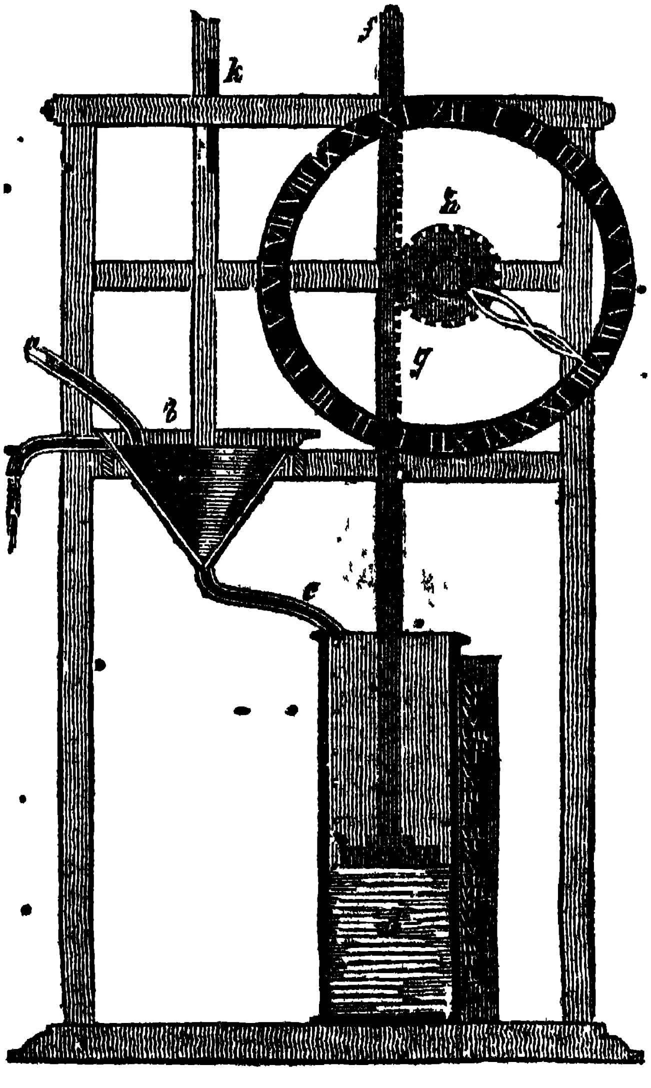
Page 120, col. 2, line 3, for "Mr." read "Dr."
Page 126, col. 2. line 22, for "falling" read feeling."

THE LONDON
MECHANICS' REGISTER.

> "Instruction is the food of the mind; it is like the dew and the rain and the rich soil. As the soil and the rain and the dew cause the tree to swell and put forth its tender shoots, so do books and study and discourse feed the mind, and make it unfold its hidden powers. Reverence then your own mind, receive the nurture of instruction, that the man within you may grow and flourish. You cannot guess how excellent he may become."
>
> MRS. BARBAULD.

No. 66.] SATURDAY, DECEMBER 24, 1825. [Price 3*d*.

COMPOUND WATER CLOCK.



OBSERVATIONS ON ANCIENT HOROLOGICAL INSTRUMENTS.

THE CLEPSYDRA, OR WATER-CLOCK—THE SUN-DIAL—MODE OF PROJECTING IT, &c.

(From Mr. Partington's Mechanics' Gallery.)

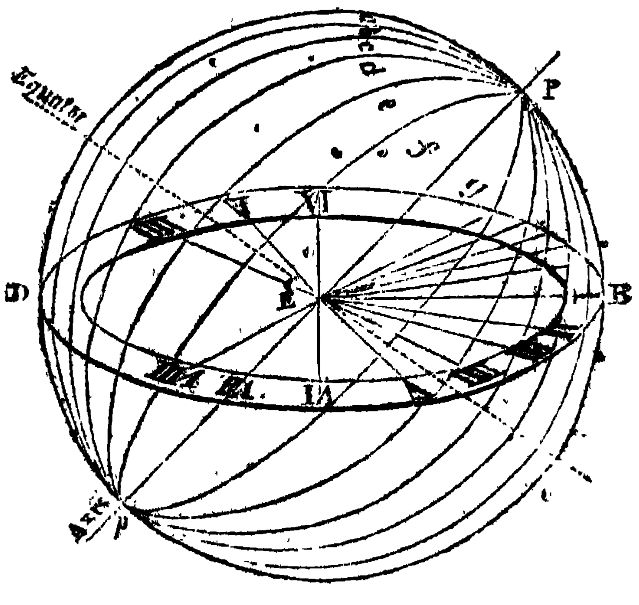
[Continued from page 140.]

A THIRD and more complicated mode of constructing this instrument may now be referred to. The figure in the frontispiece is furnished with a wheel and rack, capable of indicating the hours upon a dial-plate, *in addition to* a series of perpendicular divisions. The conical funnel, *b*, is supplied by a pipe, *a*, while a solid cone and stem, *k*, is made to regulate the passage of the water by the pipe, *c*. Should the water enter too rapidly, it is carried off by the waste pipe, *l*; so that the hydrostatic pressure, or tendency to descend at *c*, always remains the same.

Having thus seen how the supply is to be regulated, we may now examine the method by which the hours are indicated. The float, *e f*, is furnished with a rack, *g*, which will, of course, ascend as the water rises in the vessel; and the teeth communicating with the wheel, *h*, readily produces a rotatory motion; so that the time is known both by the graduated cylinder and the hour circle, round which the band is made to pass. The ratchet, *k*, is intended to regulate the supply of water, by elevating or depressing the cone beneath.

Having thus noticed a few facts illustrative of the first invention and subsequent improvements in this machine, it may now be advisable, though of course but briefly, to point out the simplest mode of constructing the *sun-dial*, which is an instrument still very generally employed, both in Europe and Asia.

The art of dialling consists principally in projecting, on a given surface, such lines as will coincide with the shadow of an index, or gnomon, parallel to the earth's axis, at intervals corresponding to the different hours of the day: so that nothing more is necessary for the construction of a dial, than to determine the intersections of the surface on which the dial is to be delineated, with planes passing through the edge of the gnomon, and situated at equal angular distances from each other: thus, supposing the plane of the dial perpendicular to the gnomon, and parallel to the equinoctial, the hour lines of the dial will be at equal distances from each other; but, in other cases, their distances will be unequal, and must be determined either by calculation or by construction.

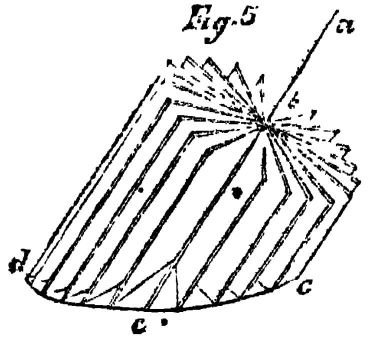


The projection of a dial, depending as it does, on the compound motion of the earth and sun, must evidently require an acquaintance with spherical trigonometry; but the general principles of the art of dialling, may be aptly illustrated by reference to a diagram, representing a hollow sphere, with the plane of the dial passing through its centre.

Thus, if we suppose D, P, B, *p*, to represent a transparent view of the earth, its equator must be divided into twenty-four equal parts, by so many meridian semi-circles, as *a*, *b*, *c*, *d*, *e*, &c.; one of these will represent the geographical meridian of some given place, as London, being situated at the point, *a*. Now, if the hour of twelve were marked at the equator, both upon that meridian and upon the opposite one, and all the rest of the hours in order on the other meridians, they would form one great hour-circle for London; because, as the sun appears to move round the earth in twenty-four hours, he will pass from one meridian to another in one hour, which will thus agree with the graduation shewn above. Then, if the sphere had an opaque axis, as P, E, *p*, terminating in the poles, P and *p*, the shadow of the axis, which is in the same plane with the sun, and with each meridian, would fall upon each particular meridian and hour, when the sun came to the plane of the opposite meridian, and would, consequently, shew the time at *a*, and at all the other places on the same meridian. If a graduated circle, B, D, be now drawn through the rational horizon of London,* one half of the axis, E P, will be above the plane, and the other, of necessity, below it; and if straight lines were drawn from the centre of the plane to the points where its circumference is cut by the hour-circles of the sphere, we shall have defined the hour-lines of a horizontal dial for London. The same result will be attained if the dial be placed in an upright position, or at any other given angle to the plane of the horizon; so that it will be seen that the plane of every dial represents the plane of some great circle on the earth, whilst the gnomon represents its axis.

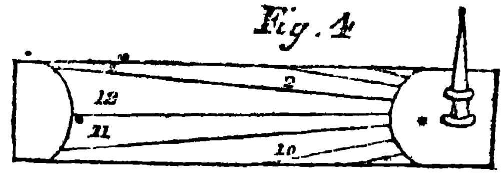
The first of the following figures shows a ready mode of converting an equatorial dial into one whose plane, is parallel to that of the horizon:—

Fig. 5



Horizontal, or Equatorial Dial.

Fig. 4



Obelisk, or Pointed Gnomon.

a b represents a rod parallel to the earth's axis, and the twelve planes passing through it, mark, at their upper extremity, the hour-lines of an equatorial dial The circle, *d*, *c*, *e*, of which, the divisions at the side, *d*, are materially elongated, may be considered as the plane of a horizontal dial. In the second figure, a point is employed instead of a rod or wire: in the latter arrangement, however, a considerable extent of surface is required.

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* By the *rational* horizon, is meant, a great circle, having its plane passing directly through the centre of the earth, so that all the points of the rational or true horizon are at a distance from the place of observation, equal to one quarter of the earth's circumference. The term is usually employed in contradistinction to the *apparent* or *visible* horizon, which may readily be defined as the boundary of our visual organs, with reference to the earth and sky, and which, indeed, seldom exceeds fifty miles in any one direction.

LONDON MECHANICS' INSTITUTION.

MR. COOPER'S ELEVENTH LECTURE ON CHEMISTRY.

RELATIVE PROPORTIONS OF THE CONSTITUENTS OF POTASH—COMBUSTION OF POTASSIUM IN CHLORINE—CHLORIDE OF POTASSIUM—SCALE OF CHEMICAL EQUIVALENTS—CHLORATE OF POTASH—PERCUSSION GUNS—INSTANTANEOUS LIGHT—IODIDE OF POTASSIUM—HYDRIODATE OF POTASH—POTASSURETTED HYDROGEN—SULPHATE OF POTASH—CARBONATE AND BI-CARBONATE OF POTASH—ALKALIMETRY, &c.

FRIDAY, DECEMBER 16TH.

HAVING, in his preceding Lecture, treated, at considerable length, of the alkaline substances *potash* and *pearl-ash*, their manufacture as articles of commerce, their decomposition and the re-union of their elements, Mr. COOPER proceeded, this evening, to point out those substances with which they are capable of entering into combination. He wished, however, first, to say a few words more on the composition of *potash*. This substance has been proved to be a compound of *potassium* and *oxygen*, but the exact proportions in which these constituents unite, have not yet been stated. The Members will recollect the experiment of the combustion of *potassium* in *oxygen gas*, and, if, on that occasion, a certain definite quantity of the metal, say 40 grains, had been employed, it would have been found, that these 40 grains were capable of combining with 24 cubic inches of the gas. Now, as 24 cubic inches of *oxygen* weigh 8 grains, and this quantity enters into combination with 40 grains of potassium, it follows, that 48 is the combining weight, or equivalent number of *potash*. Mr. Cooper here referred to the large scale of chemical equivalents, alluded to at page 89, and requested the audience to observe, that *oxygen* stood opposite number 8 in the scale, *potassium* opposite 40, and *potash*, the compound resulting from their union, opposite 48, the sum of the two numbers. [We may here observe, that the scale of equivalents, constructed under the direction of Mr. Cooper, is the largest ever yet formed, and, from its obvious utility for the purposes of public illustration, we have no doubt that scales, upon the same extensive and excellent plan, will be adopted at other Institutions, where chemical lectures are given to large audiences.]

It has been seen that *potassium* is capable of combining with one of the supporters of combustion, viz., *oxygen*, and it remains to be shewn, that it also unites with *chlorine* and *iodine*, the other two supporters of combustion, forming compounds, called, respectively, *chlorides*, and *iodides of potassium*. In order to exhibit these combinations, it is necessary to employ means analogous to those adopted on the last occasion, by inclosing *potassium* in an atmosphere of the gas with which it is to be united. Mr. Cooper, therefore, exhausted a retort, in which a piece of *potassium* had been previously placed, and supplied the place of the atmospheric air with *chlorine;* observing, that if the surface of the metal was perfectly clean, it would ignite spontaneously in the gas, the moment the two substances came in contact. Such, however, is the affinity of *potassium* for *oxygen*, that its surface rapidly oxidizes, or becomes tarnished; and the *chlorine* combining with the oxidized surface, forms a kind of crust, which, in some degree, protects the pure metal from the action of the gas, and renders it extremely difficult to exhibit the phenomenon of spontaneous combustion. It is, therefore, necessary to assist the operation, by applying a little heat to the retort, by means of a spirit lamp. This was accordingly done, and the *potassium*, in a few seconds, burst into a brilliant red flame, and continued to burn till it had entered into combination with a specific portion of the *chlorine*, forming the compound called *chloride of potassium*.

Now, if 40 grains of *potassium* are employed in this experiment, it will be found, that the weight of the *chloride*, formed by its combustion in the gas, is considerably greater, and the question is, what quantity of *chlorine* these 40 grains have combined with? This question is easily resolved, if a specific quantity of chlorine be employed; for instance, 100 cubical inches, which are known to weigh 76 grains and a fraction; for, by ascertaining the quantity of gas which remains uncombined, we can readily arrive at the quantity that has united with the metal, and it will be found, that 40 parts of *potassium*, by weight (whether grains, ounces, pounds, &c), unite with 36 of chlorine, by weight, and give 76 as the equivalent number, or combining weight of *chloride of potassium*. The scale of equivalents was again referred to, and the three substances, *potassium*, *chlorine*, and *chloride of potassium*, appeared opposite the numbers mentioned by the Lecturer, viz., 40, 36 and 76. Thus, another example was afforded of the mode of obtaining these numbers, and of the utility of the scale in pointing out the relative proportions in which the various substances combine.

Thus, it has been shewn, that *potassium* combines with *chlorine*, to form *chloride of potassium*; and it was pointed out, some time ago, that *muriatic acid* is composed of *chlorine* and *hydrogen*; now, if the *chloride* be dissolved in *water*, which is a compound of *oxygen* and *hydrogen*, the resulting compounds will be *muriatic acid* and *potash*; the former being produced by the union of the *chlorine* of the *chloride of potassium* with the *hydrogen* of the water, and the latter, by the combination of the *potassium* of the *chloride* with the *oxygen* of the *water*. The converse of this experiment is shewn by acting on *muriatic acid* with *potash*. Mr. Cooper then exhausted a retort, containing a quantity of *potash*, and filled up the vacuum, by admitting into the retort some *muriatic acid gas*, previously confined in a vessel standing over quicksilver in the mercurial trough. An evident chemical action immediately ensued between the two substances, and a whitish cloud appeared in the retort. Mr. Cooper accelerated the operation by applying the heat of a spirit lamp, and observed that, in this case, no combustion takes place, though other phenomena are observable. The lights in the theatre were then lowered, and a vast number of extremely minute, but vivid scintillations, were seen darting from the surface of the potash, which continued till the new combinations were formed, by the decomposition of the substances employed. In this experiment four elements are present, viz., *chlorine*, *hydrogen*, *potassium*, and *oxygen*, and a double decomposition takes place; the *hydrogen* of the *muriatic acid* passing over to the *oxygen* of the *potash*, and forming *water*, which was seen trickling down the interior of the retort, while the *chlorine* of the *muriatic acid* seized the *potassium* of the potash, forming *chloride of potassium*; the same compound that was produced by the combustion of the metal in chlorine gas.

Now, the proportions in which all these substances have combined, may be seen by a single glance at the scale of chemical equivalents, in which their names appear against the numbers indicating their respective weights, as follows:—*hydrogen* 1, *oxygen* 8, *water* 9, *chlorine* 36, *potassium* 40, *potash* 48, *chloride of potassium* 76. But if any other quantities of the same substances are employed, the scale points out, with equal facility, the relative proportions they must bear to each other. Suppose, for instance, we wish to operate on 100 parts of *potash*; it is only necessary to shift the slider till the number 100 is opposite the name of that substance, and the corresponding weights of the other bodies will be immediately pointed out by the numbers which appear against their names. The slider of the scale of equivalents was then raised, till *potash* appeared on a level with 100, when the relative quantities of the other substances mentioned, appeared nearly as follows:—*hydrogen* 2¼, *oxygen* 17, *water* 19¼, *chlorine* 75, *potassium* 83, *chloride of potassium* 158.

It has been stated, on a former occasion, that *chlorine* and *oxygen* combine to form *chloric acid*, or, as it was formerly called, *hyperoxymuriatic acid*. This acid, when united with potash, forms the salt called *chlorate of potash*; to produce which, it is necessary to have recourse to *carbonate of potash*. Mr. Cooper exemplified, on a small scale, the process adopted in large manufactories for producing *chlorate of potash*, by employing a retort, containing the materials from which *chlorine* is generated. This retort communicated with two vessels, the second of which contained a solution of carbonate of *potash*; and, upon applying heat to the retort, *chlorine* was given off in considerable quantites, and passing through the connecting tube, deposited in the first vessel any impurities it contained, while the *pure chlorine* was conveyed to the liquid *carbonate of potash*, and, entering into combination with the *potash*, formed the *chlorate*, or *hyperoxymuriate of potash*.

If the solution of *carbonate of potash* employed in this experiment, be not too weak, the *chlorate* is formed in crystals, similar to those now exhibited by the Lecturer. This salt gives out *oxygen*, at a dull red heat, with considerable facility, and is decomposed by several combustible bodies: in some instances, merely by *percussion*. On this account, it is used for percussion guns, in the form of pellets, which detonate by the fall of the hammer, and ignite the powder contained in the barrel.

This salt is also used in the preparation of the matches employed for the production of instantaneous light, by immersing them in a bottle containing *sulphuric acid.* All that is necessary in preparing the matches is, to use a proper quantity of the *oxymuriate* or *chlorate of potash*, so that there may be enough *oxygen* to combine with the combustible body. Mr. Cooper here pounded a portion of the crystallized *chlorate of potash* in a mortar, and mixing it with some *loaf-sugar* on a metallic plate, he threw some *sulphuric acid* upon it, when the whole instantly burst into a violent blue flame; and the substances employed were so nearly proportioned to each other, that very little of the *charcoal* contained in the *sugar* remained unconsumed. The same effect would have taken place, if *starch* or *gum*, or any vegetable substance, containing a considerable quantity of *carbon*, had been used in the experiment.

When *sulphur*, *phosphorus*, and some *metallic bodies*, are triturated with this salt, a series of detonations takes place; and the Lecturer particularly cautioned the Members against experimenting with percussion powders, as they are attended with considerable danger; several persons having sustained severe injuries, and two individuals having, upon one occasion, been instantaneously killed by the explosion produced by *chlorate of potash*.

The next supporter of combustion, with which *potassium* combines, is *iodine*. No very rapid action takes place when these substances are exposed to each other, but by the application of a gentle heat, they sometimes act upon each other with sufficient energy to produce combustion. Mr. Cooper here produced a tube, containing a piece of *potassium*, surrounded by an atmosphere of *iodine*; and, to facilitate the mutual action of the two substances, he held the tube in the flame of a spirit lamp, when, in a few seconds, to the evident surprise of the Lecturer, as well as the audience, a violent explosion took place, and the tube flew from his hand. It was an extraordinary circumstance that the tube fell upon the lecture table, without sustaining the slightest injury; and Mr. Cooper, on taking it up, observed that, though the combination had taken place with more force than he had ever before witnessed, he had not *burst his gun*, (*laughter*) for the tube remained perfect, and was lined with the *iodide of potassium*; the compound resulting from the combination of *potassium* and *iodine*. He was disposed to attribute the detonation which had occurred to the presence of some extraneous or adventitious substance; for he had repeatedly performed the same experiment before, without the occurrence of a similar explosion. This circumstance was, however, sufficient to shew how necessary it was to use extreme caution in operating with combustible substances, and to recollect the old adage, that "a gun might go off, charged or not charged." (*Laughter.*)

Iodide of potassium has been produced in this experiment by the direct combination of its two elements, and the same compound may be formed by acting with *iodine* on a solution of *potash*. In the latter case, however, two results are obtained, as, in addition to the *iodide*, a second compound is formed, called *hydriodate of potash*. This substance is a very useful test for detecting the presence of metallic bodies, and for determining the names of the metals in solution, by the different colours of the precipitates. Mr. Cooper here poured into two vessels, containing *hydriodate of potash*, two *metallic solutions*, one of which immediately assumed a *scarlet*, and the other a *pale yellow* colour; the former indicating that *mercury*, and the latter that *lead*, was the metal held in solution. *Hydriodate of potash* might be of great use in the arts, as one of the most brilliant *scarlets*, and a very beautiful *yellow* colour, are produced by its agency; but the expense of the article is, at present, so great, that it prohibits its use for those purposes.

Potassium also combines with *hydrogen*, and forms *potassuretted hydrogen*; a substance which is spontaneously inflammable. It is also capable of combining with *sulphur* in a variety of ways. It may be recollected that, when speaking of *sulphuretted hydrogen*, a portion of *potassium* was heated in this gas, and, during its combustion, united with the *sulphur*, while the *hydrogen* was set at liberty. *Potassium* and *sulphur* may also be made to combine by the direct union of the two constituents, as well as by heating *sulphur* and *carbonate of potash* together in a crucible; by which means we obtain a compound, called *sulphuret of potash*, which is, in fact, a *sulphuret of potassium*. In performing this experiment, it is usual to employ an excess of *sulphur*; but the exact proportions in which the *sulphur* and *potassium* unite, may be ascertained by a reference to the scale of equivalents. Mr. Cooper here introduced these two substances into a crucible, and placed them in the furnace, where they remained for some time, when the crucible was taken out and exhibited to the audience. An intense chemical action was evidently going on between the two bodies, and a vast number of vivid coruscations were thrown out. To form a perfect *sulphuret of potassium*, it is necessary that the substances should be united, without being in contact with atmospheric air; for, at a high temperature, the mixture decomposes the atmosphere, and the combined substances form *sulphate of potash*.

Potash may be united with *carbonic acid gas*, in two proportions, forming two distinct and well characterized compounds; the first of which is called the *carbonate*, and the second the *bi-carbonate of potash*. The Members should recollect, that the syllable "*bi*" signifies *twice*, and intimates that the second compound contains twice as much *carbonic acid* as the first. Thus, the salt called *carbonate of potash*, being composed of *potash* 48, and *carbonic acid* 22, according to the scale of equivalents, its combining weight is 70; but the *bi-carbonate*, consisting of *potash* 48, and *carbonic acid* 44 (or twice the former quantity), its equivalent number is of course 92.

To exemplify the difference between these two compounds, Mr. Cooper accurately weighed equal quantities of the *bi-carbonate of potash*, and introduced one of these equal portions into a vessel standing over quicksilver in the mercurial trough. The other equal portion of the *bi-carbonate* was then put into a crucible and placed in the furnace. A quantity of *muriatic acid* was then let up into the glass vessel in the trough, which, coming in contact with the salt on the surface of the quicksilver, effected its decomposition, and liberated its *carbonic acid;* which, in a short time, displaced the whole of the mercury from the vessel. Mr. Cooper then observed, that the action of heat, on the portion of the salt which had been placed in the furnace, would drive off exactly half its *carbonic acid;* but that no degree of heat would detach the other half, which would remain obstinately attached to its base, and could not be dissipated without the agency of other substances. After some time, the crucible was taken from the fire, and the substance it now contained, after being suffered to cool, was introduced into another vessel over quicksilver, and treated with *muriatic acid*, like the preceding portion of the *bi-carbonate*. The *carbonic acid* remaining in it was soon liberated, but it filled only half the vessel, instead of the whole, as in the former case; and thus, fully demonstrated that half the *carbonic acid*, originally contained in the *bi-carbonate of potash*, had been driven off by the heat, which had converted it into the common *carbonate*.

The Lecturer then pointed out a method of producing the bi-carbonate of potash, by forcing into a solution of the *common carbonate* an additional quantity of *carbonic acid*. This was effected by means of a forcing-pump; and Mr. Cooper observed that, if the *carbonic acid* was, in this manner, driven into the solution, in sufficient quantity, it would become a solution of the *bi-carbonate*, and would crystallize spontaneously. It is by a process somewhat similar to this, that *soda-water* is manufactured, by impregnating water with *carbonic acid* and *soda*.

Mr. Cooper next adverted to the observations he had made, on a former occasion, respecting the method of detecting the impurities of *potash*, and observed that, before he quitted the subject, he would point out an easy mode by which any adulteration in alkaline substances might be discovered. The only apparatus necessary for this purpose is a pair of accurate scales; a graduated tube, and a bottle of *sulphuric acid* of a known strength. Now, in order to determine the strength of an *alkali*, it must be remembered that all substances combine in certain definite proportions, and, therefore, that to any given quantity of *alkali* a definite quantity of *acid* must be added, in order to produce a perfectly *neutral* compound, in which the most delicate tests shall not discover the presence of either *acid* or *alkali*. Mr. Cooper now weighed, with considerable care, 100 grains of *pure carbonate of potash*, and observed, that the tube he held in his hand was graduated into 100 equal parts, and contained *sulphuric acid*, of such a strength, that the 100 measures would form a perfectly neutral compound with the quantity of *pure carbonate* which he had weighed. The *sulphuric acid* was then poured upon the *carbonate of potash*, when *carbonic acid* was evolved in considerable quantities; and, as soon as the action ceased, the neutral character of the compound was demonstrated, by its not occasioning the slightest change in the colour of either litmus or turmeric paper.

To illustrate the utility of this simple apparatus in detecting impurities, Mr. Cooper then weighed exactly the same quantity of the common *pearl-ash* of commerce, and poured *sulphuric acid* upon it, from the graduated tube, till the compound became *neutral*, as in the first experiment. In this case, however, the compound assumed a neutral character, long before the tube was empty; and it appeared, upon examining the graduated scale, that only 73 measures of *sulphuric acid* had been required to neutralize the whole of the *alkali* contained in the 100 grains of *pearl-ash*. It was therefore seen in a moment, by the quantity of *sulphuric acid* remaining in the tube, that the *pearl-ash* contained 27 per cent. of impurity. This mode of ascertaining the exact quantity of *pure alkali* contained in any *alkaline* substance, is called *alkalimetry*, and affords a striking illustration of the doctrine of definite proportions.

LECTURES FOR NEXT WEEK.

Wednesday, December 28, Mr. Gowring's Second Lecture on Pneumatics.

Friday, December 30, Mr. Cooper's Thirteenth Lecture on Chemistry.

READING MECHANICS' INSTITUTION.

MR. OGG'S INAUGURAL LECTURE.

Dr. Birkbeck and **Mr. Brougham** having been frequently applied to by Mechanics' Institutions in the country, to send them a suitable Lecturer, they have consulted with **Mr. Ogg**, to know if his engagements, in and near London, would permit a part of his time to be devoted to country institutions; and having received a favourable answer, they have determined to recommend that gentleman, as being capable of lecturing, with great advantage to the Mechanics, on every department of Chemical and Natural Philosophy. Mr. Ogg's first engagement, in consequence of this recommendation, has been at Reading, where he was invited to give an inaugural lecture; a report of the proceedings, at which we present to our readers.

The meeting was announced to take place on Tuesday, the 13th instant, at seven in the evening; at which time, the very spacious town-hall was crowded with mechanics and their friends.

The President, Mr. Williams, commenced the proceedings by an appropriate address; tracing the progress of intellectual improvement from the establishment of Lancasterian and Sunday schools; encouraging the mechanics to proceed with zeal in their new undertaking; proving that the nation at large has an interest in their progress,' from the consideration, that intellect is public property; and he concluded with a warm, but just, eulogium on the freedom which our excellent constitution affords for the adoption of any measures intended to promote the public good. The worthy President's address was received with much approbation by the mechanics, by whom he is greatly and deservedly esteemed. He then presented Mr. Ogg, one of the Lecturers of the London Mechanics' Institution, to the Meeting; stating that he had been strongly recommended by Dr. Birkbeck; and he (the President) doubted not but they would experience high mental gratification from his exertions.

Mr. Ogg commenced his lecture, by stating, that the great object which the friends of Mechanics' Institutions wish to promote, is to improve the condition of the working classes. They think that "the diffusion of knowledge must be productive of that happy effect in several different ways.

First. By making them understand the scientific principles connected with their several occupations, by which they will be rendered more skilful.

Secondly. It is believed that a knowledge of the general principles of science, must often lead mechanics to new inventions, which may be of great use to them and to their country.

And, *Lastly,* It is believed that great moral improvement, and, consequently, increased happiness, must result from turning the attention of the working classes, to the pleasing and profitable pursuits of science.

It must be admitted that the arts and manufactures have mostly attained their existing degrees of perfection, from the application of scientific knowledge to them; but science is progressive; then, surely, the continued and more extensive application of science to them must be productive of continued and increasing improvement. Practical workmen have the most intimate knowledge of all the niceties and peculiarities belonging to their processes; and if, in addition to this, they possessed scientific knowledge, how much would their sphere of observation be enlarged and what clearness of perception they would acquire! The eye that is enlightened by science, sees deeper, and more clearly, into any operation; its imperfections, and the means of improvement. I have often remarked that, even in common life, trifling circumstances will teaze and perplex those uninstructed in science, that would not give a moment's uneasiness to scientific persons.

To illustrate this, Mr. Ogg related several amusing anecdotes, shewing what ready resources science affords for removing many of the little difficulties, and repairing many of the little accidents, that occur in common life; and then proceeded with the subject of the lecture.

A knowledge of the general principles of science would also, in many instances, prevent those who possess that knowledge from wasting their time, and exhausting their energies, in following unprofitable pursuits. How many ingenious men have ruined their families, and reduced themselves to despair, by persevering in the hopeless pursuit of that illusive phantom, *perpetual motion*.

A large portion of the useful arts and manufactures owe their discovery and improvement to individuals of the working classes, who did not possess facilities equal to those now possessed by mechanics; for they may now, not only obtain scientific knowledge, but they are brought into contact with persons who will gladly assist them; first, in perfecting any invention or discovery, and, afterwards, in securing to them its full advantages.

That many persons have fallen victims to unsuccessful efforts of genius, for want of such countenance and aid, as are now so liberally extended to them, cannot be doubted.

> "Ah! who can tell how hard it is to climb
> The steep, where Fame's proud temple shines afar!
> Ah! who can tell how many a soul sublime
> Hath felt the influence of malignant star,
> And waged with Fortune an eternal war;
> Checked by the scoff of Pride, by Envy's frown,
> And Poverty's unconquerable bar,
> In Life's low vale remote hath pined alone,
> Then dropt into the grave, unpitied and unknown."
>
> MINSTREL.

Providentially, there is now no want of benevolent, enlightened, and munificent patrons of the working classes. The wise and good, of all ranks, and of different countries, are, at this time, vieing with each other in expressing sentiments favourable to Mechanics' Institutions.

The great mathematical philospher, the Marquis de la Place, rejoices that the truths of science are now taught to those who have the best opportunities of applying them. His Royal Highness, the benevolent and condescending DUKE of SUSSEX, declared, in the midst of mechanics, that the feelings of his heart went along with them in their endeavours for improvement, and that he would further their views to the utmost of his power. One of His Majesty's ministers of state, the enlightened EARL of LIVERPOOL, in a recent speech, used words to this effect;—"God forbid that any kind of useful knowledge should be prevented from finding its way to any class of men."

There are timid persons, it is true, who, with the best intentions, err, in being afraid that the more general diffusion of knowledge among the working classes, will have the effect of raising their minds above their stations in life: in opposition to this, however, there is the general experience of employers, that the best informed of those they employ, are generally the most useful, as well as the most agreeable. In perfect accordance with this opinion was the declaration of an eminent engineer, who employs a great number of men, and who, when recently examined before a committee of the House of Commons, stated that the best educated were always the most estimable. A mechanic cannot acquire much knowledge, without learning that the prosperity of a country greatly depends upon the perfection of its mechanical arts; hence, he will see the importance of his avocation, and feel that the practice of an art that tends to promote the prosperity of the state, must be honourable: but if, after skilfully and faithfully serving his employer, he should have ability and good-fortune enough to become an employer himself, who can deny that he has a right to his advancement? or who can point out any evil likely to result from such promotion?

Perhaps, those fearful persons are apprehensive that there may be too great an influx of talent; that an army of young philosophers may muster at Mechanics' Institutions; march in hostile array to the seats of learning and science; besiege the Professors chairs, and carry them all by mere force of genius.

Again, they are afraid that the diffusion of knowledge among the working classes may tend to fit men to be the instruments of disaffected and designing persons; in doing injury to church or state.

If we take a retrospective view of the troubles of states, we shall see that, in the majority of popular commotions, the vilest and most ignorant have always been uppermost:—*the ignorant alone are fitted to be the dupes of the designing.*

The timid objectors are afraid, also, that the regular and necessary gradations of society may be disputed; that, in proportion as the working classes are elevated by the acquirement of knowledge, the higher classes will seem to be depressed. This is a weighty consideration, indeed. They are afraid that mechanics, by devoting an hour or two after the labours of the day, to the improvement of their minds, may become wise enough to make the others suffer by comparison!!

There is, however, an effectual remedy for this evil: let those of higher rank diligently avail themselves of all the superior advantages, and employ all the superior facilities which they possess for the acquirement of knowledge, and they may easily retain the vantage-ground upon which they have been placed by education.

Thus, the improvement of the working-classes, it is probable, will occasion a new stimulus in the pursuit of knowledge, which may contribute to the improvement of all classes of society, and to the elevation of the national character.

It has been said, that such an excessive degree of refinement is ominous, inasmuch as it indicates the usual symptoms of approaching decay. Nations have usually arisen from comparatively small beginnings, and, having attained a state of eminence in arts and arms, they have gradually become enervated by excessive refinement.

It is true that our beloved country has attained a high place in the scale of nations; but it is not true that the desire for imparting and receiving knowledge which prevails at present, is at all like the refinement which is symptomatic of decline: on the contrary, it indicates renewed youth, and increasing prosperity. It is not while a nation is active in enlarging the sphere of useful knowledge, and in improving the arts, that it is verging to decay; but when the people sink into indolence, and exercise no other ingenuity than that which is calculated to pamper their diseased appetites, and minister to their sensual enjoyments.

It is confidently expected, that the diffusion of knowledge will have the effect of improving the moral character of the labouring classes, by withdrawing them from habits and amusements injurious to themselves and their families, and giving them a taste for the ennobling pursuits of science.

The influence of philosophy in preparing the mind for virtuous and intellectual exertion, and the enjoyment of delicate pleasure, is beautifully described by the learned and philosphical author of the Minstrel:—

"But now let other themes our care engage,
For lo! with modest yet majestic grace,
To curb imagination's lawless rage,
And from within the cherished heart to brace,
Philosophy appears. The gloomy race
By indolence and moping fancy bred,
Fear, discontent, solicitude give place,
And hope and courage brighten in their stead,
While on the kindling soul her vital beams are shed.

Then waken from long lethargy to life,
The seeds of happiness, and powers of thought;
Then jarring appetites forego their strife,
A strife by ignorance to madness wrought.

* * * * * * * *

——————— the mind untaught,
Is a dark waste, where fiends and tempests howl,
As Phœbus to the world, is science to the soul."

In another place the Poet says:—

"Nor less to regulate man's moral frame
Science exerts her all composing sway.
Flutters thy breast with fear, or pants for fame,
Or pines to indolence and spleen a prey;
Or avarice, a fiend more fiercer than they?
Flee to the shades of Academus' grove;
Where cares molest not—discord melts away
In harmony, and the pure passions prove
How sweet the words of truth breathed from the lips of love."

The Lecturer made some remarks on the refined pleasures of science, and then said, I shall now introduce a few experiments for the purpose of shewing some of the extraordinary properties that matter possesses, and for the purpose of proving the necessity of being acquainted with these properties of matter, before a right understanding can be had of the action of the particles of matter of different kinds upon each other, in the multifarious processes of the arts.

The experiments will be introduced, not so much to impart information, as to excite a desire for obtaining it.

A number of beautiful and striking experiments were then exhibited and explained, and the Lecturer concluded with the following remarks:—

I trust the experiments which have been introduced, will have a tendency to prove that science gives to man an extraordinary degree of power over the particles of matter and their properties. I might almost venture to say, that a man of science has the spirits of the earth and the air at his command, for they come at his call, and perform his pleasure with unerring accuracy and irresistible force. The assertion which I have just made, may appear an enigma, which the future philosophical proceedings of this institution will, I hope, effectually solve.

"Knowledge," it has often been said, "is power," and I hope the future experience of the Mechanics of Reading will, under Divine Providence, prove, that knowledge gives power, not to do mischief, as some apprehend, but to become wiser and still more industrious men, kinder husbands, more judicious fathers, firmer friends, more amiable and more useful members of society.

The Lecture was received throughout, by the numerous assembly, with the strongest marks of satisfaction. The Secretary then made some judicious remarks, and the business of the evening was concluded.

ROTHERHITHE AND BERMONDSEY MECHANICS' INSTITUTION.

The First General Meeting of the Members of this Institution was held on the 12th instant, in the large room of the Jamaica Tavern, Bermondsey, when **Daniel Brent**, Esq., being unanimously called to the chair, the Report of the Committee, appointed to frame the laws, was read and received with the greatest applause, by upwards of 210 actual subscribing Members.

The Report was of a very gratifying nature, and, amongst other particulars, stated that 230 persons had, without solicitation, entered their names as Members, of whom, 210 had already paid their subscriptions;—that a considerable number of books had been presented to the Institution; and that, from the promises they had received of further donations, of a similar kind, they entertained a sanguine expectation of forming, in a short time, a large library for the use of the Members;—that six gentlemen, of great talent, had agreed to deliver gratuitous lectures, on various branches of experimental philosophy;—and that, from the great encouragement they had received, from persons of all classes, they had no doubt that the Institution would abundantly flourish.

The Report further stated the amount of money received, and the amount expended in the formation of the Institution, which had been laid out with the most persevering regard to economy.

The laws for the government and constitution of the Institution, were then read, and unanimously adopted; after which, the Officers of the Institution, and the Committee of Managers, were chosen.

Thanks were returned to Mr. **Pelham**, for his kindness in accepting the office of Secretary, and for his efficient and valuable services hitherto rendered:—to Mr **John Lewthwaite**, as the first promoter of this Institution, and for the unequalled liberality he had shewn, in affording accommodation to the Committee during their operations:—to the Committee, for their disinterested labours, and to the Chairman, for his impartial and able conduct in the chair, at this meeting.

The meeting was conducted with the utmost harmony and good order, and the whole of the proceedings afforded the highest satisfaction.

LAWS OF MOTION.

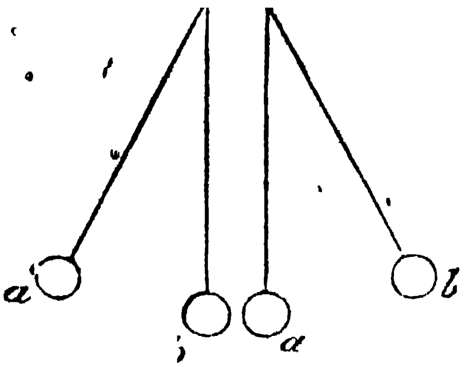
To the Editor of the Mechanics' Register.

Sir,—Your military Correspondent, Mr. F. M. of Nottingham, has, in your 62d Number (page 95), favoured me with "*a shot.*" It certainly cannot but surprise me, that your correspondent, who recently aimed at so high a mark as "the gallant Captain Forman," should condescend to notice such poor game as N. R.: as it is, however, I am, of course, duly sensible of the honour of being "*fired at*" by so distinguished a sportsman. His ostensible purpose, indeed, is to introduce to your readers Dr. Wood; if we are to understand that gentleman to be referred to, when he talks about "the impenetrable buckler of his author's learning." But we look in vain for his "*impenetrable buckler*"; unless indeed, that ghost of a calculation at the end be intended. If that be the case, F. M. has certainly behaved rather impolitely in bringing in the learned gentleman at the fag end of his speech; for no other reason, it would appear, than to grace the close of his graceless epistle.

It is pretty evident, however, that his real purpose, (as indeed, he expressly declares,) was to show his

agility in *shooting* your unfortunate correspondent. It is well for F. M. that he has not to deal with a person of Mr. R. Martin's irritable temperament, or he would certainly have to find securities to keep the peace. For myself, however, I cannot say that I felt much alarm at the threats of your valiant correspondent, and the event has proved that there was little ground for apprehension. The only part of his *charge* that has reached me, is a certain piece of paper, much disfigured with sundry black marks and scratches; the meaning of which, if indeed, they be designed to convey any meaning at all, it would puzzle a clerk to decypher. In fact, I suspect my valorous friend must have loaded his piece with powder only, without ball; for after a fizz and a pop, his terrific threats ended in smoke. (I may observe, in passing, that "*ex fumo dare lucem*" is, in this case, a tolerably difficult undertaking.) Perhaps, however, by some such process as that which Lord Byron describes in his "English Bards and Scotch Reviewers,"* the "vengeful lead" has found its way from your Correspondent's gun to his sapient noddle. And to say truth, from the general tenor of his brilliant position, the latter conjecture appears the more probable. So well has he acquitted himself in his double capacity of *shooter* and *writer*, that he might set up for teacher of both arts; in which case, Caleb Quotem's advertisement might be suggested as not inapplicable:—
"Young ideas and sportsmen, taught to *shoot*."

Short as is your correspondent's letter, he has contrived to encumber the subject with a deal of extraneous matter. No lawyer could have shown more ingenuity in making a clear subject dark, than your correspondent has displayed in rendering a very plain question perplexed and intricate. The point at issue between Juvenis Admirator and myself is very simple. "The third law of motion," he observes, "may be exemplified by suspending two ivory balls, of equal weight, by threads, in the manner represented in the figure:—



"Now," he continues, "if the ball, *a*, be lifted a little out of the perpendicular, and let fall upon *b*, the former will lose its motion by communicating it to the latter, and will remain at rest in the perpendicular; while the ball, *b*, will be propelled to a distance *equal to that from which a fell.* Eight balls may be suspended in a similar manner, and three of them let fall against the rest; when those three, and the two in the middle, will remain stationary, while the three last will fly up to a height *equal to that from which the others fell.*" To this point, as will be seen by referring to my letter, my remarks were solely directed. To Juvenis Admirator's statement I objected, that at every successive vibration, the altitude of the balls will diminish, until they will "remain at rest in the perpendicular."

Now this is no abstruse question, requiring the aid of Dr. Wood and mathematics for its elucidation. Two balls, suspended by threads, constitute all the apparatus necessary. This would settle the matter at once, but F. M. disdains to make use of such simple means of investigation, and has chosen to talk about "elasticity," "exchange of velocities," &c.; no wonder, therefore, that he has only succeeded in perplexing himself and his readers. This confusion is manifest throughout his letter. "Gravitation," "oscillation," and "perpetual motion," are all jumbled together, "in most admired disorder." Instead of applying himself steadily to the matter under discussion, and giving an intelligible opinion thereupon, he passes from subject to subject, without saying anything determinate on either. This irregularity renders it the more difficult to follow your correspondent with that precision which is desirable. I shall, however, attempt to notice his remarks, as nearly as possible in the order in which they occur.

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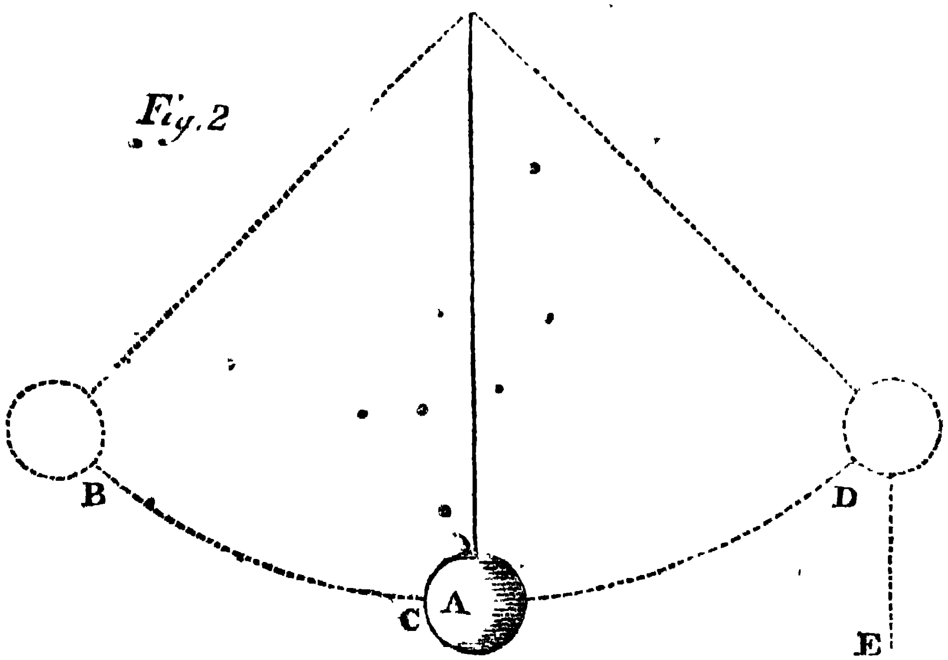
* "From either pistol snatched the vengeful lead,
And straight restored it to her favourite's head."

"Juvenis Admirator," he says, "is *accused* by his antagonist, of having found the perpetual motion." Now, Mr. Editor, the *accusation* in question is one of which Dr. Wood, or any other Doctor would be proud; but should F. M. think otherwise, he may console himself with the reflection, that it is an accusation of which *he* is never likely to become the subject. As to its truth, however, it must be evident to every one (I suppose I must except F. M.) that if the statement of Juvenis be correct, he has really succeeded in discovering the *perpetual motion*. For if the force acquired by *a* in its descent, be sufficient to elevate *b* to a height equal to that from which *a* fell, it is quite clear that the descent of *b* will have a similar effect on *a*; which, being carried up to its original elevation (according to Juvenis Admirator), will again descend to cause the same series of motions. Thus the balls will continue to be alternately propellant and propelled; in other words, a *perpetual motion* is produced. Perhaps F. M. will deny that!

The next particular which demands our attention, is that on which he lays particular stress, *gravitation*. "In order," he says, "to make the case more plain" (there never was a "*case*" which stood more in need of such elucidation), "I must premise, that whatever effect gravity produces to stop the balls, as here described, the same would be produced in the case of *one ball alone*, oscillating in circular arcs." Be it so! glad indeed, am I to find a point, on which I can come to close quarters with an opponent, who is so perpetually shifting his ground. This is, in fact, the only sentence in his letter which really bears on the point in dispute; and now that he has said something decisive, we shall find no difficulty in coming to an understanding. Let A then, represent a ball, oscillating in the arc B C D.

Fig. 2



Now then, does F. M. mean to say, that if A were elevated 45 degrees, as at D, and allowed to fall by its own gravity, it would rise 45 degrees on the other side, as at B? If this be his meaning, every school-boy, who has read Blair's "Preceptor," will laugh at him; if this be not his meaning, his letter was irrelevant and unnecessary, since we have seen, that this was the only point in dispute between Juvenis Admirator and myself. That the ball *b* (Fig. 1.) "will *not* rise to the same height as the other," is evident to every one, F. M. excepted. I do not except even Juvenis himself; for long ere this, his good sense cannot have failed to convince him, that at each successive vibration, the altitude would diminish, until the oscillation would entirely cease.

Your deep-read correspondent conceives, "that N. R. requires a *little more reading* on this subject when he mentions gravitation as tending to destroy the motion." Had your correspondent read no farther than the bottom of the page on which my letter appeared, he would have found a note, from which he might have learned more on the subject of terrestrial attraction than he appears to have acquired from all the attention he has bestowed on his favourite author. "Now in the case of the ball," he continues, "gravity not only produces no effect to stop the pendulum, but, on the contrary, is the very cause of its motion." It is plain that your very acute correspondent considers it totally impossible for gravitation to be both the cause *of the motion*, and the *cause of its destruction*. He will doubtless therefore, be surprised when I give it as my opinion, that it is *both the one and the other*. I fear this has too much the appearance of a paradox to be comprehended by F. M., but I anticipate no difficulty in convincing the rest of your readers. When the ball A (Fig. 2.) is elevated to D, it would, by the attraction of gravitation, fall to the earth in a perpendicular direction, as shown by the line E; were it not restrained by the string by which it is suspended. It, therefore, describes the arc D C. When it has reached the lowest point C, gravity will incline it to remain at rest, because it is now in the line of centripetation; but the momentum which it has acquired by its descent, causes it to ascend on the other side, describing a portion of the arc C B. Immediately on its commencing its upward course, the attraction of gravitation, which was before in its favour, is now opposed to its progress. Here, then, gravity, which was before the cause of the motion, now tends to check, and, ultimately, to destroy it. At the next vibration the momentum is less; and the altitude is, in consequence, diminished. The defalcation continues to increase, until at length, the ball "remains at rest in the perpendicular."

"The greater the force of gravity," he concludes, "the quicker goes the pendulum:" what then? Does the celerity or tardiness of the vibration affect the relative height of the ball? The force of gravity, which assists it in its descent, will operate to its disadvantage when it commences its ascent. Let A oscillate ever so quickly, the force of gravity which accelerates the motion, will have a proportional influence in tending to destroy it.

My parting advice to F. M. is,—to take a temporary leave of Dr. Wood,—to close the "book which lies open before him,"—to bid farewell, for the present, to mathematics,—and to think no more of "*elasticity*," and "*circumference of circle radius*." Then let him borrow his brother's top, (if his own be not at hand), and suspend it, by fastening a string to its leg. I venture to predict that, with half an hour's experimenting with this apparatus, he will arrive at conclusions on the subject of *gravitation*, more correct than any that he has ever yet attained.

I am Sir,
Your obedient servant,
Dec. 9, 1825. N. R.

THE KALEIDOSCOPE.

To the Editor of the Mechanics' Register.

SIR,—I conceived it possible to throw the objects seen in the kaleidoscope on a screen, similar to those used with the magic lantern, or on any transparent body; and I attached a tube to a magic lantern for that purpose, but was disappointed in my expectations; for there appeared two objects, neither of them distinct, but one much more so than the other; and on turning the tube they approached each other, and passed to the other side of the circle of light. But seeing our worthy President, Dr. BIRKBECK throw the microscopic objects on the screen by the ignition of lime, the idea was again revived in my mind, and I was induced to trouble you, if you think proper to insert this in your useful work, as some of your ingenious correspondents may inform me whether my suggestion is practicable, and, by what means; and if it is not, what is the cause of failure; as some beautiful objects might be seen, either for amusement or delineation.

I remain your's, &c.

G. E.

MR. DEWHURST'S MACHINE FOR BORING PIPES.

To the Editor of the Mechanics' Register.

SIR,—In the 63d Number of your useful publication (page 107), I read of a machine invented by your intelligent Correspondent, Mr. Dewhurst, for boring wooden pipes, and which I consider incomplete; and shall, with your permission, suggest an improvement on it. According to the representation, neither the drill, nor the pipe, makes any advance, consequently, two persons must be employed — one to turn the wheel, and the other to press the pipe forward. The improvement I propose is simply this:—The centre-bit, B, to have a screw attached to it, about one foot long, or more, and to turn into a box similar to the screw of a vice; and, instead of the cog-wheel, E, the centre-bit to be thickened at that part, and fluted, for the upper cog-wheel to play in, of the same length as the box and screw. Now, by this plan, only one person need be employed; because, as the large wheel turns, the drill lengthens, and continues to do so, till all the screw is winded out; then, by drawing it back again, and placing the pipe the length of the screw nearer to it, the operation may be continued, without further help or loss of time.

As all communications inserted in your Register are intended to benefit the public, and are, consequently, exposed to examination and correction, I think it unnecessary to apologise to Mr. Dewhurst for the liberty here taken.—Your obedient servant,

WILLIAM WILLIAMS.

Soho, Westminster.

QUERIES.

No. 25.

It is well known that oxygen and chlorine are electro-negative bodies:—How is it they unite, both being in the same state of electricity?

Rye. TYRO.

No. 26.

What substance will give the most *light*, without any *smoke*, and the least possible *heat?*

S. M. T.

ANSWERS TO QUERIES.

QUERY No. 24, Vol. III., Page 108.

POLISHING PLASTER CASTS.

Let your New Subscriber put into four pounds of clear water, one ounce of pure curd-soap, grated and dissolved in a well-glazed earthen vessel—then add one ounce of white bees'-wax, cut into thin slices; as soon as the whole is incorporated it is fit for use. Having well dried the figure before the fire, suspend it by a twine, and dip it once in the varnish; upon taking it out, the moisture will appear to have been absorbed in two minutes' time; stir the compost, and dip it a second time, and this generally suffices. Cover it carefully from the dust for a week; then, with soft muslin rag, or cotton-wool, rub the figure gently, when a most brilliant gloss will be produced.

TYRO.

Rye.

The same process is recommended by another Correspondent, who also adds the following:—

Take skimmed milk, and, with a camel's-hair pencil, lay over the model till it holds out, or will imbibe no more. Shake or blow off any that remains on the surface, and lay it in a place perfectly free from dust; when dry, it will look like polished marble, and answers equally well with the former, except it is put outside the house in wet weather.

N. B. If the milk is not carefully skimmed, it will not answer.

S. S. E.

We have also received the following recipe, from a third Correspondent:—

Fuse half an ounce of tin, with the same quantity of bismuth, in a crucible; when melted, add half an ounce of mercury, and when perfectly combined, take the mixture from the fire and cool it. This substance, mixed with the white of an egg, forms a most beautiful varnish for plaster of Paris casts.

A MEMBER OF THE LONDON
MECHANICS' INSTITUTION.

QUERY, No. 1, Vol III., Page 13.

YEAST.

I smiled on reading the description of fermentation, by Mr. Thomas Taylor, No. 58, page 32, and was surprised at his subtle reasoning, "that yeast is an *acid*, by its soon turning sour;" thereby giving a direct proof that it is not; for, if it were an acid, how could it *turn* sour? The remainder of the explanation is very incorrect. The nature and composition of *yeast*, or *ferment*, is not well ascertained, but late experiments render it probable that it is ***gluten***. If a mixture of five parts of sugar, twenty of water, and one of yeast, be introduced into a matrass, furnished with a double bent tube, the end of which is made to pass under an inverted jar in the hydro-pneumatic trough, the following phenomena will present themselves:—If the materials in the matrass be exposed to a temperature of from 70° to 80°, we shall speedily observe the syrup to become muddy, and a quantity of ærial matter is formed all around the ferment. These unite and attach themselves to particles of the yeast, rise along with it to the surface, forming a stratum of froth. The yeast will then disengage itself from the air, falling to the bottom of the vessel, to reacquire a fresh buoyancy a second time by attached air bubbles, and thus in succession; at the same time bubbles of *carbonic acid* will continue to pass over into the jar of the pneumatic trough. After a certain period, this intestinal motion will cease, and the fluid, depositing a sediment, will become clear; it is now no longer sweet, but has acquired a new taste, and it is capable of producing an intoxicating effect. The agency of *yeast* is involved in great obscurity. It has been supposed, that, from its strong attraction for *oxygen*, it attracts a part of it from the sugar, forming the *carbonic acid*, while its *hydrogen* and *nitrogen* combine with the remaining element of the sugar, and form *alcohol*. The equilibrium between the particles of the sugar being subverted by the yeast, these so re-act on each other, as to give rise to the series of combinations, whence the remaining *carbonic acid* and *alcohol* are produced.

Yeast may be made expeditiously in the following manner:—

Boil one pound of good flour, a quarter of a pound of brown sugar, and a little salt, in two gallons of water for an hour. When milk warm, bottle it and cork it close. It will be fit for use in twenty-four hours. One pint of this will make eighteen pounds of bread.

Rye. TYRO.

QUERY, Vol. I. Page 286.

COLOURING CRYSTALLIZED ALUM BASKETS, &c.

Perhaps the following methods of colouring crystals of alum will not be unacceptable to your Correspondent, W. G. C., and to many of your readers.

To procure a *yellow*,—muriate of iron. *Blue*,—solution of indigo in sulphuric acid. *Pale blue*,—equal parts of alum and blue vitriol. *Crimson*,—infusion of madder and cochineal. *Black*,—Japan ink thickened with gum. *Green*,—equal parts of alum and blue vitriol, with a few drops of muriate of iron. *Milk-white*,—the crystals of alum held over a glass, containing ammonia; the vapour of which precipitates the alumina on its surface.

Rye. TYRO.

QUERY, No. 18, Vol. III. Page 108.

ENGLISH GRAMMAR.

In reply to your Correspondent, R.X., (No. 18, p. 108,) I beg to state, that the word *theirs* ought not to be written with an apostrophe; because it is not the possessive of *their* but *they*; while *it's*, on the contrary, should be written with the mark of elision; but, by the carelessness of some, and the ignorance of others, printers generally have a silly practice of writing it without the mark of elision, although it is, unquestionably, the possessive of *it*. The pronouns, *ours*, *yours*, *theirs*, *hers*, &c., should always be spelt without an apostrophe. Indeed, so great is the confusion with respect to the possessive case, that we frequently meet with books in which the apostrophe is used in *plurals*, and omitted in *singulars*.

Rye. TYRO.

TO CORRESPONDENTS.

The observations of R. D. G., and G. H., on Mr. Gordon's Theory of the Thunder Storm, will appear, if possible, in our next.

Communications have been received from W. W.—JUVENIS ADMIRATOR—W. D.—A SUBSCRIBER—W. H. H.—I. N. H.—AN ENQUIRER—F. C.—LUTHER—I. P., &c.

THE LONDON

MECHANICS' REGISTER.

> "Excellence is never granted to man, but as the reward of labour. It argues indeed no small strength of mind, to persevere in habits of industry without the pleasure of perceiving those advances, which, like the hand of a clock, whilst they make hourly approaches to their point, yet proceed so slowly, as to escape observation."
>
> SIR J. REYNOLDS.

No. 67.] SATURDAY, DECEMBER 31, 1825. [Price 3*d*.

PLAN FOR CONSTRUCTING A LIFE-BOAT.

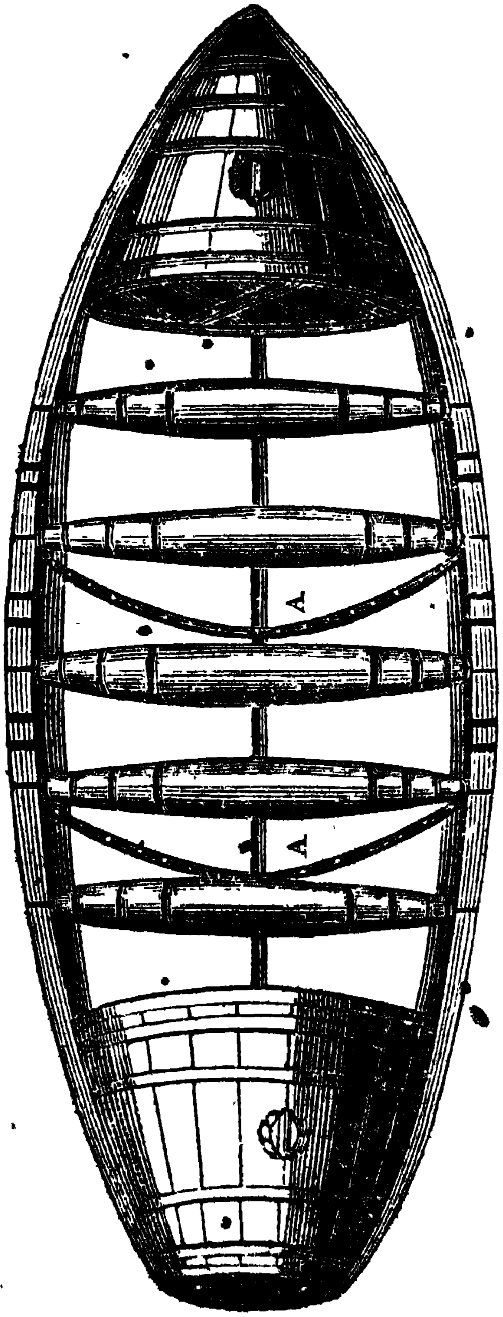


Fig 1

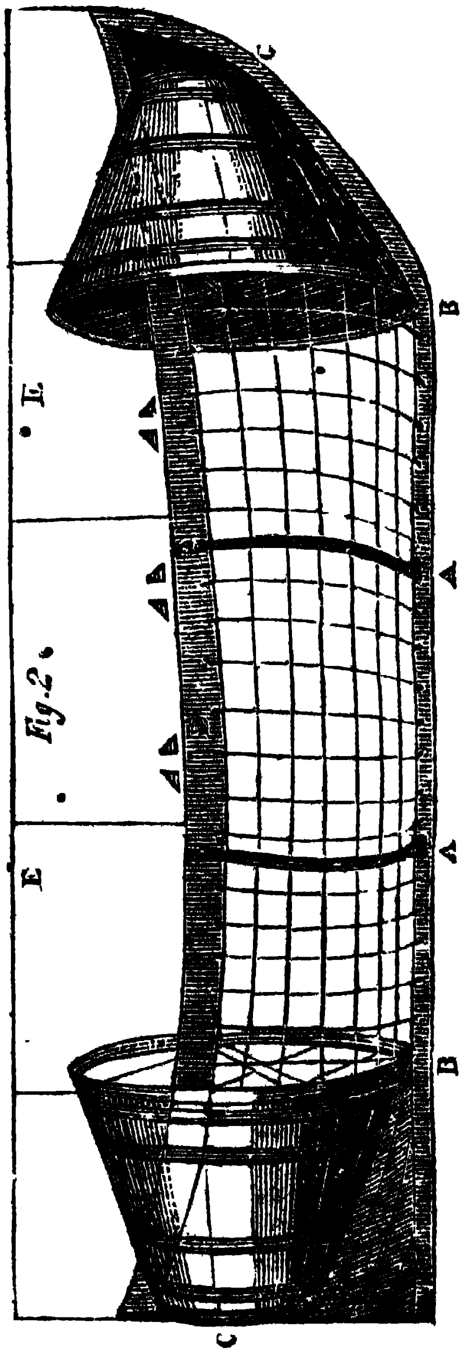


Fig. 2

PLAN FOR CONSTRUCTING A LIFE BOAT.

To the Editor of the Mechanics' Register.

SIR,—Herewith I send you a rude sketch of a plan for constructing a *Life Preserver Boat*, which I shall be happy to see inserted in the pages of your valuable Register, if you think it deserving the attention of your readers. Fig. 1 is an open view of the top of the boat, and it will be seen that any common boat may be fitted up on a similar principle, so as to prevent it from sinking, in case it should be filled with water.

I propose, however, to have the Life-boat made as a complete *skeleton*, the keel to be formed of wrought iron, which will strengthen the boat, and serve as ballast. A sufficient number of strong iron ribs should cross the keel as at A, A, and be secured to it by strong pins. Wires of sufficient strength must be placed in the direction B, B, (Fig. 2) passing through the ribs A A, and securely fastened at each extremity.—Other wires must cross the former in the direction of the ribs, and pass through the keel, or be properly fastened to it. The ribs and wires must be securely fixed to a strong timber D, going lengthways at the top of the boat on each side. I then propose to have a bell cask, hooped securely down to the keel at stem and stern, as at B, C, (Fig. 2.) and also to have the seats made of cooper's work, projecting in the middle on both sides, and underneath, but flat along the upper part.

I also suggest that the upper part of the bell casks might be made rather flat, and have each a large bung-hole, with a wooden bung, made to fasten down, and rendered air-tight by a piece of wash-leather, as at *e*, *e*, (Fig. 1.) In these casks (if time would allow of it when the boat was wanted) might be stowed many small valuables, such as watches, monies, small books, writings, &c. which would be kept perfectly dry and safe for a length of time.

In order to afford the passengers more safety, a rod of iron E, E, might be run round the boat, at the height of 15 or 18 inches above it, and supported by uprights, as in the figure. Now as Mr. Scheffer's Life Preserver is more than sufficient to prevent one man from sinking, I would ask, how many persons a boat of this kind would carry, supposing the two bell casks, and the hollow seats, to hold 100 gallons of air? I should think a good boat-full, as I believe 100 gallons of salt or sea-water, would weigh 1050lbs. However, in loading such a life-boat, it would soon be seen how many passengers it would carry, with the upper part of the body above water; and whatever number it would support in the first moment, I have no doubt it would continue to ride in safety with over a rough sea for hours, as the boat would get no fuller of water; and with less motion than a common boat, the body being so open, that a strong wind would blow through it, and a rough sea would beat through it, without encountering the resistance offered by the solid sides of an ordinary boat. I have proposed cooper's work, because it appears to me that it would render the boat capable of standing a blow, in case it should strike; and I hope the plan I have proposed will answer the purpose to which I have thought it adapted.

I am, Sir, your constant reader,
W. W.

LONDON MECHANICS' INSTITUTION.

MR. GOWRING'S FIRST LECTURE ON PNEUMATICS.

INTRODUCTORY REMARKS—MECHANICAL PROPERTIES OF GASES—AIR PROVED TO BE A BODY—EXPERIMENTS DEMONSTRATING ITS WEIGHT—PRESSURE AND RESISTANCE—AIR-PUMP—BAROMETER—SUCKING-PUMP—MAGDEBURGH HEMISPHERES—SUCTION DISPROVED—BREAKING SQUARES—FOUNTAIN IN VACUO, &c.

WEDNESDAY, 21st DECEMBER.

MR. GOWRING this evening delivered the first of a Course of Lectures on the very interesting science of PNEUMATICS. As this subject has been recently elucidated by Mr. PARTINGTON, in the Lectures which preceded his able illustrations of the Steam-engine, and which were very minutely detailed in our Second Volume, we shall endeavour to avoid unnecessary repetition, by noticing rather briefly those portions of Mr. Gowring's Lectures, in which the same experiments may be introduced, for the purpose of exemplifying analogous facts, and dwelling only on such remarks or experiments as have not yet been detailed in our pages.

Mr. Gowring commenced by observing that in the science of PNEUMATICS there are but few principles to establish, as it depends chiefly on experiments. It is derived from a Greek word, signifying air, and may, therefore, be defined to be "The doctrine of gases." The atmosphere which surrounds us is a compound of *oxygen*, *nitrogen*, and *carbonic acid*, the various *chemical* properties of which it is the office of the chemical Lecturer to unfold; but the *mechanical* properties of all gases are alike, and the science of Pneumatics appertains only to these mechanical properties, and comprehends an illustration of their *weight* or *pressure*, their *spring* or *elasticity;* of the fact that the latter is equal to the former; and also that air is the medium of sound.

That *air* is a fluid, is readily proved by its particles moving easily among each other; but it is necessary, in the first place, to demonstrate that it is a body, for this fact is not evident to all the senses. Air, for instance, is invisible, and it is not, under ordinary circumstances, obvious to the sense of feeling. If, however, it is a substance, it must possess the most obvious property of matter, that of *occupying space.* Mr. Gowring demonstrated this fact by several experiments, which have been already detailed; such as the inversion of a glass in a vessel of water; the resistance of the air confined in a bladder; the water-hammer; the experiment with vanes presenting, during their revolution, greater or less surfaces to the air, &c. A very ingenious variation of the latter experiment was performed, in the following manner:—Two vanes, situated one above the other, and revolving on separate spindles, were placed under a receiver, and the upper vane being put in revolution, the motion communicated to the air soon caused the lower vane to revolve with equal rapidity. The receiver was then exhausted by means of the air-pump, and the upper vane was again spun rapidly round; but, as the air was now removed, the lower vane remained at rest, and thus afforded an unequivocal proof of the materiality of the air, with which it had been previously surrounded.

In performing this, and some other experiments with the *air-pump*, the Lecturer observed that the Members must, for the present, take it for granted that, by the operation of this instrument, the air could be withdrawn from any receiver that was placed on the pump-plate, and he requested them to observe the cloudy appearance assumed by the interior of the receiver, as soon as the exhaustion commenced. This is occasioned by the deposition of the *water* which is contained in the atmosphere, in the proportion of about one per cent., and which the air holds like a sponge, and, upon being removed from the vessel, deposits on its interior surface, in the form of vapour or steam.

Mr. Gowring also illustrated the resistance of the atmosphere by what is commonly called, the *guinea and feather* experiment; but, as guineas are now rather a scarce commodity, he remarked that it ought rather to be called the *sovereign* and feather experiment. The audience are perfectly aware that, if these two substances are allowed to fall from any given height, at the same moment, they will reach the ground in very different periods of time, when exposed to the resistance of the air; but this is not the case when that resistance is removed. A sovereign and three feathers were then introduced into the upper part of a lofty receiver, where they were supported by an apparatus, by which they could be liberated, either at the same moment, or one at a time. The receiver was then exhausted, and the Lecturer, after requesting the Members to keep their eyes fixed on the bottom of the receiver, liberated the sovereign and the feathers, and they all struck the pump-plate at the same instant of time. This, then, is a satisfactory proof that *gravity* acts equally on all matter, whether light or heavy, and that it is the resistance of the air which occasions the difference in the velocities of falling bodies.

The Lecturer then repeated the interesting and decisive experiment, of *weighing* a portion of *air*, contained in a pint flask, and, afterwards, the same quantity of *hydrogen gas;* thus demonstrating their materiality, by the difference in the weight of the flask, when exhausted, and when filled with these substances, and also their different specific gravities. He also observed that, in exhausting the receivers for pneumatic experiments, the vacuum produced was not quite perfect, owing to the imperfection of the instruments employed; and that the nearest approach to an absolute vacuum was made by Torricelli, in his celebrated experiment which led to the discovery of the *barometer*. Mr. Gowring performed this experiment with a barometrical tube, and, after explaining the principles upon which the mercury is supported in the tube, by the pressure of the atmosphere, he further demonstrated this fact, by repeating the experiment with another tube, which, instead of being hermetically sealed at the upper extremity, was closed by a piece of bladder. In this case, the mercury was supported, as before, at the height of about 28¾ inches, with the vacuum above it; but, upon piercing the bladder with a pin, so as to restore the equilibrium, by admitting the air into the vacuous space, the whole of the mercury instantly sunk into the vessel at the bottom of the tube.

Mr. Gowring next observed, that a column of *mercury*, about 29 inches high, and covering an area of a square inch at its base, weighs about 15lbs., and is equal to a similar column of water 33 feet in height; and as the pressure of the atmosphere counterbalances this weight, it consequently presses with a weight of about 15lbs. on every square inch. The Lecturer then alluded to the enormous weight of the whole atmosphere, which is found, by calculation, to equal that of a sphere of lead upwards of 60 miles in diameter, and also to the immense weight (more than 13 tons), which presses upon a man of ordinary size, without his being sensible of the pressure, owing to its being exactly counterbalanced by an equal pressure from within. He next applied the principle of the pressure of the atmosphere to the construction of what is erroneously termed the *sucking-pump*, the operation of which, he explained by a suitable diagram, and by two very excellent models. [For a handsome engraving of this diagram, and a further account of the sucking-pump, see Vol. II. page 294, &c.]

The pressure of the atmosphere was further illustrated by exhausting the air from a receiver covered with a piece of bladder. The bladder, in this instance, was sufficiently strong to support the great weight which pressed upon it, but burst with a loud report, upon being perforated with a pin, owing to the amazing velocity (1300 feet in a second of time) with which the air rushed in to fill the vacuum. A piece of thin glass, under similar circumstances, was shivered to atoms. The Lecturer also exhausted a bladder of the air it contained, when it collapsed, and was pressed together by a force which the strongest man in the theatre could not have overcome, so as to pull it asunder, though this was effected with perfect ease, the moment the air was allowed to enter the bladder.

Mr. Gowring then adverted to the equal pressure of the air in every direction, and illustrated its upward pressure, by the experiment with a cylinder and piston, to which a piece of lead was attached, and also by inverting a wine-glass filled with water, and merely covered with a piece of paper (vide Vol. II. pp. 281. 308). He then performed the celebrated experiment of the Magdeburgh Hemispheres, invented by Otto Guericke (vide Vol. I. page 332; Vol. II. pp. 283. 291), one of the earliest discoverers in the science of Pneumatics. The small hemispheres used by Mr. Gowring, required all the strength that could be exerted by himself and his assistant, to drag them asunder, after they had been exhausted, though, upon suspending them beneath a receiver, and exhausting from it the air which pressed them together, they fell asunder by the mere weight of the lower hemisphere.

After observing, that all these effects have been, by some persons, erroneously attributed to *suction*, Mr. Gowring proceeded to demonstrate the fallacy of this idea by several decisive experiments. That the force with which the receivers are attached to the pump-plate when the air is withdrawn from them, is occasioned, solely, by the pressure of the exterior atmosphere, and not by any *suction* exerted by the air-pump, was shewn in the following manner:—A large receiver, within which was suspended a very small one, was subjected to the operation of the air-pump, and the air being withdrawn, both the vessels were, of course, exhausted. The small receiver was then caused to fall upon a part of the pump-plate, entirely unconnected with the orifice through which the air is withdrawn or re-admitted. Upon now introducing the air into the larger vessel, it was readily removed from the plate, while the small one still remained firmly fixed to it, and could only be detached by sliding it over the orifice to re-admit the air. As the small receiver, in this case, had no communication with the interior of the pump, it was obvious, that *suction*, if the machine possessed such a property, could have had no influence upon it. The non-existence of *suction* was further illustrated by an elegant experiment with the *double transferrer*, which we have already described at page 291 of our Second Volume.

The next experiment was performed with a small bottle of a square form, called a *breaking square*, and furnished with a valve, opening outwards. This little bottle was placed under a receiver, and the air, being exhausted, both from the receiver and the bottle, was subsequently re-admitted into the former, and the construction of the valve preventing its admission into the bottle, the pressure of the atmosphere was enabled to act on its flat surfaces, and it was broke into a thousand pieces in a moment. The Lecturer had previously observed that the circular form of the receivers prevents them from being broken by the weight they have to sustain when exhausted.

Cupping instruments and *milk-glasses* owe their operation to the pressure of the atmosphere, and the same principle was exemplified by forcing *air* and afterwards *mercury*, through the pores of wood, solely by atmospheric pressure. In the former experiment, the air rose in innumerable bubbles to the surface of some coloured water, in which the lower extremity of the piece of wood was immersed, and in the latter, the mercury descended in a fine stream to the bottom of the exhausted receiver. Mr. Gowring finally performed the beautiful experiment of the *fountain in vacuo*, which we have formerly had occasion to describe (vide Vol. II. pp. 283 297); but in those instances, the jet was produced by the *elasticity* of the air, whereas, in the present, the same effect resulted from the *pressure of the atmosphere*.

Mr. Gowring concluded his very amusing and instructive Lecture, by observing, that he had now terminated his experiments on *air*, considered as *a body*, and as possessing *weight*, and exerting *pressure*. He had been requested, six months ago, by Dr. Birkbeck and the Committee of Managers, to deliver a course of lectures to the Members, but he had not been able to comply with this request till the present time; and he should not have selected a subject which had been so lately illustrated, if there had been sufficient time for him to make other arrangements. He trusted, however, that, though the subject was not new to his audience, he might have clothed it in new words, and perhaps have advanced some ideas with which they were not before familiar.

MR. COOPER'S
TWELFTH LECTURE ON CHEMISTRY.

SODA—ITS MANUFACTURE FROM BARILLA AND KELP—CARBONATE OF SODA—ALKALIMETRY—BI-CARBONATE OF SODA—USE OF BARILLA IN THE ARTS—MODE OF PURIFYING IT—SODIUM, THE METALLIC BASE OF SODA—ITS ACTION ON WATER—TESTS FOR DETECTING POTASH—MURIATE OF PLATINUM—TARTARIC ACID—FORMATION OF CREAM OF TARTAR—COMBUSTION OF IODINE IN OXYGEN—SULPHATE OF SODA, OR GLAUBER'S SALTS—MURIATE OF SODA, OR COMMON SALT, BORAX, &c.

FRIDAY, DECEMBER 23D.

Soda, the substance which we are now about to examine, observed Mr. Cooper, is, in many of its most important characteristics, nearly allied to *potash*, the subject of the last lecture. There is, indeed, a striking analogy between the two bodies, and the object of the present evening's discourse will be, principally, to point out those peculiarities in which they differ from each other. It will be recollected, that *potash* was stated to derive its origin from *inland* plants, and that another *alkali* was obtained from *marine* plants, or such as grow on the sea-shore. These plants are found in great abundance, and consist principally of the *fuci* and *algæ*, but the substances which they produce differ very much in their appearance. There is an article of commerce, called *barilla*, which is imported from Spain, and there is another article called *kelp*, which is the produce of our own shores. Now, both these substances are employed for the production of *soda*, by a process analogous to that adopted in the manufacture of *potash*.

Mr. Cooper here exhibited large specimens of *barilla* and *kelp*, and observed, that though their names were very different, their properties were similar, as they consisted of the same ingredients in different proportions. Both of them are *alkaline* substances, and are used in large quantities by soap-makers and glass manufacturers, as well as in other processes, where it is of importance to obtain *alkalis* at a cheap rate. *Barilla* is, however, much higher in price than *kelp*. To obtain *soda* from *barilla*, this substance must first undergo the process of *lixiviation*, or washing, previous to which, it must be broken in pieces and pounded. Mr. Cooper, in order to exemplify this process, broke off some portions of *barilla* from the large lump he had exhibited, but this was accomplished with some difficulty, owing to the excessive hardness of the *barilla*, which was vitrified by the intense heat employed in its manufacture. Some portions of it having been pounded, were exposed to the action of warm water, in which they readily dissolved, and formed a solution which instantly changed the colour of turmeric paper, and, therefore, evidently contained a large quantity of *alkaline* matter. Now, in order to exhibit the properties of this fluid, it is necessary to free it from the impurities with which it is contaminated, for which purpose, it was first poured through a filter, and became a clear solution of *carbonate of soda;* still, however, contaminated with a variety of impure matters, the most important of which, are *neutral salts*. It will be remembered, that *potash* was also deteriorated by an admixture of *neutral salts;* but in the present case, these salts contain a quantity of *soda*. This solution, therefore, contains a quantity of *uncombined alkali*, or alkali in a free state.

Mr. Cooper then dissolved a portion of *kelp* in warm water, in a similar manner, and demonstrated the *alkaline* properties of the solution by the same test. The *alkali*, however, exists in these fluids in combination with a quantity of *carbonic acid*, which, therefore, constitutes the compound a *carbonate of soda*, though there is also present a portion of *free*, or *uncombined alkali*. That the solution is a *carbonate of soda*, may be proved by the addition of *sulphuric acid*, which will liberate the *carbonic acid*. This was accordingly done, and the gas was immediately evolved in considerable quantities.

The process of *alkalimetry*, detailed in the last lecture, and applied to the alkaline substance, *potash*, is equally applicable to *soda;* for, by adding to an impure solution of *carbonate of soda*, a quantity of *sulphuric acid*, exactly sufficient to neutralize the *alkali* contained in the solution, the quantity of the latter may be correctly ascertained, which is a circumstance of considerable importance to soap-makers, glass-makers, and other manufacturers who use this *alkali* in large quantities. It should also be observed, that the import duty on *barilla* is paid only on the quantity of *alkali* it contains, and not on the whole mass; so that, if *barilla* contains only 25 per cent. of *alkali*, the manufacturer pays the duty on that quantity only. A knowledge of the process by which this quantity may be discovered, is, therefore, of essential importance.

Mr. Cooper here gave another striking example of the utility of *alkalimetry*, by operating on 100 grains of *pure carbonate of soda*, with 100 measures of *sulphuric acid*, contained in the graduated tube exhibited in the last lecture (page 151), and of such a strength as exactly to neutralize the quantity of the *carbonate of soda* employed. He then weighed 100 grains of *barilla*, and having dissolved it in warm water, in consequence of its vitrified state rendering it rather insoluble, he cautiously added to it as much sulphuric acid as was necessary to saturate the whole of the *alkali* it contained. The graduated tube then indicated, that the quantity of *alkali* in the *barilla* was only 24 per cent., and, consequently, that all the rest of it, amounting to 76 per cent., consisted of impurities. The obvious importance of this simple operation to purchasers of the article, had induced him to dwell upon it, for the purpose of impressing it on the minds of his audience.

In order to prepare pure *carbonate of soda* for the experimental purposes, it is necessary to treat *barilla* repeatedly with hot water in the manner described; pouring off and evaporating the solutions to a certain extent, when the *carbonate* will be formed in crystals similar to those now exhibited. In this crystalline salt, the constituents always unite in certain invariable proportions, but it also contains a portion of the water of crystallization. By a reference to the scale of equivalents, the relative proportions of the constituents of *carbonate of soda*, will be immediately seen. *Soda*, in this scale, is opposite the number 32, and is compounded of *sodium* 24, and *oxygen* 8. *Carbonic acid*, 22, added to *soda*, 32, gives 54 as the equivalent number of *carbonate of soda*, and against that number, the name of the compound is placed. It should be recollected, that this number does not represent *carbonate of soda* in its crystalline state, but when rendered perfectly dry, by exposing the crystals to a red heat. There is also another combination of *soda* with *carbonic acid*, called the *bi-carbonate of soda*, and consisting of two proportions of *carbonic acid* to one of *soda*.

Carbonate of soda, as it exists in *barilla*, must necessarily undergo purification, to render it available for the purposes of soap-makers, &c., by freeing it from its *carbonic acid*. To effect this, the soap-maker grinds or bruises his *barilla*, taking care not to break it too small, lest it should choke up the vessel, and become what he calls *pudding*, through which the water cannot percolate. He then covers the bottom of the large iron vessel with straw, or mats, and throws in the *barilla*, mixed, indiscriminately, with *lime*, the latter being rather in excess, and pouring water upon the whole, allows it to remain a considerable time. The *lime*, during this operation, enters into combination with the *carbonic acid*, while the *alkali* remains in solution in the water. Mr. Cooper here exemplified this process, by operating with *lime* on *carbonate of soda*, and observed that the experiment was exactly analogous to the process adopted by all manufacturers; except that they used only the rough *barilla*, while he had operated with pure *carbonate of soda*. By this means, the *soda* is freed from the *carbonic acid* with which it was combined, and the solution being evaporated to dryness, the pure *alkali* is obtained.

It is not necessary to exemplify the process of procuring the metallic substance, *sodium*, from *soda*, as it is obtained by precisely the same methods as those already particularized for procuring *potassium* from *potash*. The Lecturer here exhibited a small quantity of *sodium*, confined, like *potassium*, under *naphtha*, in a phial. It was in a fluid state, somewhat resembling quicksilver; but this is not the natural state of the metal; and it is therefore proper to explain the reason of its appearing in that form on the present occasion. The *potassium* exhibited in a previous lecture was prepared in an iron vessel, by the process then described; and, by some unforeseen circumstance, a portion of the *alkali*, used for its production, remained in the vessel. The same apparatus was used for procuring *sodium* for this evening's lecture, and thus it became combined with a portion of *potassium*, sufficient to render the *sodium* fusible at the ordinary temperature of the atmosphere. The metal produced is, therefore, strictly speaking, an alloy of *sodium* with *potassium*; the former metal being, in its pure state, rather more brittle than the latter.

The action of *sodium* upon water is somewhat similar to that of *potassium*, but the flame produced is yellow, instead of the fine purple produced by the combustion of the latter. It has been a matter of dispute, whether *sodium* inflames on the surface of water or not. Mr. Cooper, however, threw a piece of the metal on some water before him, when it instantly burst into a yellow flame,[*] and he observed that the *water* undergoes the same decomposition as when subjected to the action of *potassium*; the metal uniting with its *oxygen*, while its *hydrogen* is inflamed, and the water imbibing *alkaline* properties, by dissolving the *soda* which results from the union of *sodium* and *oxygen*.

In chemical processes, it is sometimes necessary to know which of the *alkalis* is present, whether *soda* or *potash*, or both. For detecting the presence of *soda*, the Lecturer was not aware of any satisfactory method, but the smallest quantity of potash might be readily discovered by certain tests, or re-agents. *Muriate of platinum*, for instance, will detect *potash* in any of its combinations, particularly with *carbonic* or *sulphuric acid*; the *muriate* forming an insoluble precipitate, by combining with the *potash*. But the whole of the combinations of *muriate of platinum* with *soda* are soluble in water, while those with *potash* are insoluble; especially when it is combined with the substances mentioned.

Mr. Cooper now poured some *muriate of platinum* into two vessels which stood before him, one of which contained liquid *carbonate of potash*, and the other a solution of *carbonate of soda*. In the former case, the solution became instantly clouded and opaque, by the formation of the insoluble precipitate alluded to by the Lecturer, while, in the latter, no change indicated the presence of the *soda*—the liquid remaining perfectly clear; whereas, if it had contained the smallest quantity of *potash*, its transparency would have been destroyed.

A solution of *tartaric acid* will detect *potash* in some of its combinations, but some caution is necessary in using it. Mr. Cooper poured some *potash* into a solution containing *tartaric acid*, when an immediate effervescence ensued, and he observed that, in a little time, minute crystals, which might be distinguished by a magnifying glass, would be formed. These crystals are *cream of tartar*, which results from the union of *tartaric acid* with *potash*.

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[*] The same experiment was performed by Dr. Birkbeck, during one of his lectures on Voltaic Electricity, in April last, and with the same result; for the *sodium* instantly inflamed, on coming in contact with the *water*, though the Doctor observed that this effect does not usually take place. (Vide Vol. I. p. 410.) Ed.

Having thus pointed out the means of procuring *potash* and *soda*, and the difference between the two substances, the Lecturer now proceeded to illustrate a few more of the properties of the latter *alkali*. The audience will recollect that when *potassium* was exposed to the action of the air, or to an atmosphere of *oxygen*, it entered into combination with that gas, and formed the *alkali* called *potash*. An effect, precisely analagous, takes place, when *sodium* is subjected to the action of *oxygen*. Mr. Cooper here introduced some *sodium* into a retort, which he then exhausted of atmospheric air; and, upon filling the vessel with *oxygen*, over the pneumatic trough, the metal instantly burst into a brilliant flame, and shivered the retort to pieces. This sudden effect appeared to be unexpected by the Lecturer, who attributed it to the accidental presence of some water in the retort; as, under ordinary circumstances, the *sodium* would not have inflamed in the gas without the application of external heat. *Soda*, however, was re-formed, by the combination of *sodium* with *oxygen*, and if the action had not been so rapid, he should have been able to exhibit the result to the Members.

Soda, like *potash*, combines with a variety of other substances, and forms a class of *salts* by these combinations. With *carbonic acid* it forms, as before stated, two compounds, called the *carbonate* and *bi-carbonate of soda*; the latter of which may be procured, like the *bi-carbonate of potash*, by injecting into the *carbonate* an additional quantity of *carbonic acid*, or by the simple distillation of *carbonate of soda* with *carbonate of ammonia*. The *bi-carbonate* is used in the manufacture of *soda-water*, and, together with *tartaric acid*, forms the *soda powders* in ordinary use.

Soda also combines with *sulphuric acid*, and forms *Glauber's salts*, or *sulphate of soda*, but this substance is never produced by the direct combination of its constituents. Mr. Cooper here exhibited a large piece of *sulphate of soda*, the residuum of a former process, and observed that the brown colour, with which it was tinged, was an *oxide of iron*, occasioned by its having been prepared in an iron vessel. *Sulphate of soda* is of great importance in the manufacture of *carbonate of soda*; for if the *sulphate* be mixed with *lime* and *small coal*, or any other substance containing *carbon*, and heated in a crucible, in a reverberatory furnace, the *sulphate* will be decomposed, and the *carbonic acid*, entering into combination with the *soda*, will form *carbonate of soda*. This process, which was invented by the late Lord Dundonald, was exemplified by the Lecturer, who formed the *carbonate of soda* by mixing the *sulphate* with pounded *lime* and *gas coke*, and exposing them, in a crucible, to the heat of the furnace.

The union of *soda* with *phosphoric acid* forms *phosphate of soda*; a substance which is used in pharmacy, under the name of *tasteless salts*.

It has been stated that *potassium* unites with *chlorine*, and forms *chloride of potassium*. Now, *sodium* combines in the same manner with *chlorine*, forming the *chloride of sodium*; a substance which is in general use every day, and is called *common salt*, or *muriate of soda*; which is, in fact, a *chloride of sodium*. If *salt* be thrown upon the fire, it decrepitates, or produces a crackling noise, which is occasioned by the escape of the water of crystallization, confined between its laminæ, when in the state of a *muriate of soda*; but if heated red hot, it becomes a pure *chloride of sodium*. Mr. Cooper here exhibited a large piece of *rock-salt*; observing that the cracks in its surface were at right angles with each other, and that, if it were broken, it would exhibit innumerable crystals, of a *cubical form*.

Soda, in combination with *boracic acid*, forms *borax*, a substance which is largely used in the manufactures. This substance, as imported from the East Indies, is called *tincal*, and requires purification, by dissolving it in hot water, before it forms the *borax* used in the arts. The substance which is separated from the *tincal* during this process, has not yet been chemically examined.

Mr. Cooper concluded by observing that, in his next lecture, he should treat of the properties of *lime*, and some others of the *alkaline earths*.

LECTURES FOR NEXT WEEK.

Wednesday, January the 4th, 1826, Mr. Gowring's Third Lecture on Pneumatics.

Friday, January the 6th, Mr. Cooper's Fourteenth Lecture on Chemistry.

OBSERVATIONS ON MR. GORDON'S THEORY OF THE THUNDER STORM.

To the Editor of the Mechanics' Register.

SIR,—I was present at a lecture delivered in October last, by Mr. H. to a select chemical class, on the subject of *hydrogen*, in which, I think, the nature and *cause* of thunder storms were explained in a novel and very satisfactory manner. The theory of Mr. H. although founded on the same principles as that of Mr. Gordon, inserted in the Mechanics' Register, (No. 63, p. 99) is, by his researches or conjectures on the formation of the atmosphere, from the decomposition of evaporated waters, not liable to the objection of Mr. Dalton's position, which the learned Dr. BIRKBECK, in his excellent introductory remarks to Mr. Gordon's letter, justly thinks so formidable. I consider the theory of Mr. H. tenable against this position, (the gases forming *vacua* for each other) if we admit that *atmospheric pressure*, and that grand chemical agent, *heat*, be necessary to retain them in a state of perfect chemical combination and mechanical mixture. The lecturer offered his remarks on the subject as a conjectural hypothesis of his own; and if his views be correct, and his new theory founded on philosophical principles and accurate judgment, "*Palmam qui meruit ferat*"—be the honour of the discovery his, to whom it belongs.

Mr. H. stated, that the component parts of the atmosphere, being exactly similar in all places and situations, it might appear singular, that the air taken from the surface of the ocean, perhaps thousands of miles from land, could be supplied with the necessary *oxygen*, which was supposed to be furnished by the vegetable world. The currents of winds, and the rotatory motion of the earth, would not, he thought, sufficiently account for it. Another source of supply then must be found; and if we admit the conjecture of Sir H. Davy, that the *nitrogen* of the atmosphere was an *oxide of hydrogen*, which, to him appeared an established fact, it would be easy to account for the supply. The constant evaporation from the surface of the waters, liberates the component gases, *hydrogen* and *oxygen*. The *hydrogen* immediately combines chemically, with a portion of the *oxygen*, forming an *oxide*, and the remaining portion is merely loosely and mechanically mixed, which will form atmospheric air. At the higher regions, in consequence, partly, of the deficiency of *heat*, from the radiation of the earth, and partly, in consequence of the diminished *atmospheric pressure*, the chemical combination becomes weaker, the mechanical mixture more loose, and a partial decomposition ensues. In this state, the gases are susceptible of combustion or explosion by the electric fluid.

In opposition to the opinion of a gentleman who had delivered a lecture on electricity, some time previous, in the neighbourhood, that the report of thunder was occasioned by the mere passage of the electric fluid from one cloud to another, Mr. H. stated, that, in his opinion, the noise occasioned by the transmission of the fluid was trivial, compared with that produced by the concussion of the air, in rushing together to fill the vacuum occasioned by the explosion of the gases. Still farther to illustrate this opinion, the lecturer stated, that the *silent* lightning, so frequent in summer, was occasioned by the more rapid decomposition of water, in consequence of the increased temperature, and the inevitable ascent of *hydrogen*, after its decomposition by the causes before stated, into the highest regions, where it would silently burn, if ignited by the electric fluid. Experiments were then made by Mr. H. in confirmation of this, by burning *pure hydrogen*, and exploding a mixture of *hydrogen* and *oxygen*.

I should have taken the liberty of stating these opinions to you last week, but wished to consult with a friend who took notes of the lecture alluded to.

I am, Sir,
Your most obedient servant,
R. D. G

Southampton Place, Russell Square,
19th December, 1825.

OBSERVATIONS ON MR. GORDON'S THEORY OF THE THUNDER-STORM.

To the Editor of the Mechanics' Register.

SIR,—The theory of the above gentleman, which appeared in No. 63 of your interesting publication, is, at first view, striking and ingenious; but, on a nearer and stricter investigation, I fear it will not be found to stand.

Its basis is made to rest on the supposition, that *hydrogen gas* being evolved in immense quantities, by several natural processes, near the earth's surface, it " being so much lighter than atmospheric air, rises through it to a certain height, and not being soluble in it, there floats (commixed with it) in immense fields;"—when meeting with clouds highly charged with the electric fluid, this fluid (according to known laws) in a condensed stream being discharged from one to the other, and having to pass through the fields of *hydrogen gas* and common air, aforementioned, explodes it, and hence, is made to account for the various phenomena of thunder, &c. see page 100.

Mr. G. however does not explain, or give any reason, why *hydrogen gas*, known to be *ten* times lighter than the air of the atmosphere that should, by reason of its great specific lightness, quit our atmosphere altogether, and float in regions above it, is to be kept suspended at certain convenient heights within it, to form the immense fields he mentions —which he certainly should have done. The existence of these fields, however, the worthy president of the Mechanics' Institution, Dr. BIRKBECK, has (I think) successfully shown to be impossible, as they give the experience of fact against a fanciful hypothesis.

It has been proved, by aëronauts, who have ascended to much greater elevations, than where Mr. G. places these fields, and who have even passed through clouds highly electrified, that they are nowhere to be met with; portions of the air at different heights, having been brought down, and when examined, found to differ very little, from that which is found near the earth's surface, without any portion of this gas being discovered in it.

In the upper region of the Alps, (where I myself have been) it is no uncommon thing for a spectator, with a pure cerulian sky over his head, to witness at some little distance below him, the interesting spectacle of a thunder-storm, spending its rage, and opening its sluices, on the plains below. In that situation the spectator finds the air undisturbed, and feels no inconvenience from the explosion of the gases contended for by Mr. G. But it may be said he was placed above it, and out of the reach of its influence—good—but as the lightning darts through the clouds, and partial openings in them take place, he sees lower down, on the side of the mountain, sundry hamlets, with their sturdy inhabitants, dwelling in apparent safety, in the very midst of this elemental strife—true, an accident will now and then occur, by which a tree is rent, or a chimney struck down; but when this takes place, it is also clearly attributable to the electric fluid alone, whose course may distinctly be traced, and not to the effects of explosion of the gases, which would have blown the inhabitants, in all probability, into mid-air, and spread their habitations in the dust.—Another conclusive fact may also be stated, that *hydrogen gas*, being unrespirable, no human beings could have lived, even for a few minutes, in an atmosphere so charged with it.

With respect to what we should naturally infer, (from its volatility) the escape of *hydrogen gas* to regions above the atmosphere, and which would consequently be lost to us for all purposes connected with our earth; it would seem to violate one of the known laws of nature, which goes far to prove, that nothing which has even once existed in creation, has afterwards departed from it; only, that the particles of matter of which they were composed, have become differently combined and presented to us in other forms.

Mr. Dalton's theory, which, I think, is ably supported, relieves us, however, from this difficulty. As he proves, as far as the thing will seem to admit of it, " that every gas has a *vacuum* for every other gas," by which means they become diffused through each other; the lighter being held down by the heavier: and so minutely is *hydrogen gas* dispersed throughout the atmosphere—and so small a proportion does it bear to the bulk of the latter, that it may never even be chemically detected in it.—(See Dr. B—'s letter.)

Hence might we bid adieu to the imaginary fields of *hydrogen gas*, and blow up the theory with the gas at once; but as Mr. G. seems to lay some stress on the appearance of a blue light, distinct from the bright electric spark, which he thinks is caused by the explosion of the gases, I will say a few words on that subject also.

That matter, he thinks, " is beautifully exemplified in the experiment of forming water by combining *hydrogen gas* and *oxygen gas* in a small globe, by means of the electric spark passing through it; then a quick eye will first see the electric spark, and immediately after the whole globe, as if filled with the blue light." Now, in order to show that this is no corroboration of what he attempts to prove, I will instance the case of what is termed *dry*, or *sheet lightning*— there this light is seen in the greatest perfection, unaccompanied by either thunder or rain, both of which, did it proceed from an explosion of the gases, ought, (according to Mr. G.,) to have accompanied it; but, were I to give an opinion on it, I should say, it was owing to the sudden illumination of the surface of the clouds, composed of aqueous particles, before shrouded in darkness, or else from the light passing through a thin medium of these clouds to the spectator.

Many of the phenomena he mentions, such as the whirlwind, the tornado, the water-spout, &c., which he would ascribe to a *vacuum* formed by the explosion of the gases, it is well known, often take place *silently*, or at least, without being accompanied by thunder, &c., which, were his supposition right, ought to be heard. That they are caused by a vacuum being formed in the air, is, I think, extremely probable; but, that vacuum is more likely to be occasioned by some action of the sun's rays, suddenly rarefying the particles of matter of which the air is composed, in a way not exactly known to us, seeing they generally take place in hot weather, or else in tropical climates.

The old theory of the thunderstorm, is, after all, the most consistent with fact and observation; and that to which, with our yet imperfect knowledge of these matters, we must still adhere for some time longer.

The sudden condensation of the clouds (before in a state of vapour) by the escape of the electric fluid, easily accounts for the formation of rain, hail, and even ice. A momentary vacuum must of necessity, be formed also by the sudden change before stated; and the air rushing in on every side to fill it up, would occasion the noise of the thunder. This is satisfactorily shown by the common experiment of covering a small jar over the top with a piece of skin or bladder, exhausting the air from the jar, by means of an air-pump; and when this is done, perforating the bladder with a small knife, and the air rushing in to fill the vacuum, will rend the bladder in pieces, and give a report equal to the discharge of a gun;—such being the effect produced on so small a vacuum, will easily account for what we witness on the grand scale of nature. The continuous rumbling sound, with occasional seeming discharges, I suspect, is occasioned by the effect of concussion and reverberation of the air of the atmosphere.

Some of the subjects contended for by Mr. G. I have touched on rather briefly; but I was afraid to encroach farther than was necessary on your columns, which, by this time, you probably think I have already done. Begging your excuse, I remain Sir,

Your obedient servant,

G. H.

Leigh Street.

EXPLANATION OF THE NEW ACTS FOR ASCERTAINING AND ESTABLISHING UNIFORMITY OF WEIGHTS AND MEASURES.

5th Geo. IV. c. 74, and 6th Geo. IV. c. 12.

Commencing 1st January, 1826.

A concise and well written pamphlet, under the above title, has been recently presented to the Members of the Lewes Mechanics' Institution, by their President; and the author having kindly transmitted a copy of it to us, we present the following extracts, which embrace the most prominent provisions of the recent acts of parliament, and will enable our readers to comprehend clearly the important, but necessary alterations which will take place in measures of capacity from the commencement of the new year, and the relative proportions between the present measures, and those which are about to be adopted :—

"These Acts are the result of the most elaborate researches and experiments made by the Commissioners appointed by His Majesty for that purpose; and their object is, to simplify and reform the present system of weights and measures, and to guard against the recurrence of irregularities, whilst the commercial habits of the people are respected, as far as can with propriety be done.

"The Act of the 5th of the King is the principal one, the other being passed chiefly to postpone the operation of the first. The introductory clauses point out what shall, in future, be considered as the the standards of lineal and superficial measure, and those of weight; and provide against the possibility of change, by referring them to certain invariable standards existing in nature. These clauses are not of general importance, but are interesting to science, and were rendered necessary, by the circumstance, that most of the existing *legal* standards were of indifferent workmanship and discordant among themselves, while those which, for many years, have been resorted to for accurate and scientific purposes, were wanting in the requisite character of *legal authority*.

"The principal alteration effected, is in the Measures of Capacity, with respect to which, a change has long been highly necessary. Besides the three legal established kinds, known by the names of Wine, Ale, and Corn Measure, there exist in different places, a variety of measures sanctioned only by local custom. The use of all these measures, both legal and customary, is abolished, and in their stead is to be substituted a new one, bearing a simple relation to the weight of water which it is capable of containing.

"The substance of the new Acts, with reference to Measures of Capacity, is contained in the following five articles :—

"1.—The new Imperial Gallon shall contain ten pounds (avoirdupois) weight of pure or rain water; by which the measure of all articles, as well wine, beer, ale, spirits, and other liquids, as all sorts of dry goods not measured by heaped measure, shall be ascertained. The pint, quart, peck, bushel, and quarter, shall bear the same proportion to the gallon, as heretofore. Measures may be made of any convenient shape; and when used for dry goods, shall be stricken with a round straight stick.

"2.—The measures used for coals, lime, fish, potatoes, fruit, and other goods commonly sold by heaped measure, shall be of the same capacities* respectively as above mentioned; but shall be made round, with plain bottoms. A bushel shall measure 19½ inches from outside to outside, and the heap shall be at least 6 inches above the rim. Smaller measures shall have the diameter at least double the depth, and the height of the heap shall be at least three-fourths of the depth. Thirty-six bushels shall be a chaldron.

"3.—All contracts and dealings shall be deemed to be according to the new standard, unless special agreements be made to the contrary. And no special agreement, with reference to any measure established by local custom, shall be valid, unless it shall express the proportion which such local measure bears to the new Imperial measure.

---

* Heretofore, the coal bushel contained 8¼ gallons; the taking away of the quarter gallon very nearly compensates the increase arising from the enlargement of the gallon itself; in fact, the new chaldron contains only 3-5ths of a pint more than the old one; and 4939 old bushels or chaldrons equal 4938 of the new measure.

"4.—Existing measures may be used, provided the proportions which they bear to the new Imperial measure, be printed or marked upon them. But no *new* measures may be constructed, except in conformity to the new standards.

"5.—All the laws in force, respecting defective weights and measures, shall be put in execution, for examining, seizing, and destroying all weights and measures not according to the new standards, and for punishing the persons having the same.

" WINE MEASURE.

"The Imperial Gallon is greater than the *wine*, in the proportion of 6 to 5 nearly, or as $120\frac{1}{31}$ to 100; therefore

To reduce *old* wine measure to *new*, deduct one-*sixth* part, or $16\frac{2}{3}$ per cent.

To convert *new* wine measure into *old*, add one-*fifth* part, or 20 per cent.

" CORN MEASURE.

"The Imperial Gallon is greater than the *corn*, in the proportion of 33 to 32 nearly, or as $103\frac{5}{33}$ to 100: therefore

To reduce *old* corn measure to *new*, deduct one *thirty-third* part, or $3\frac{1}{18}$ per cent.

To convert *new* corn measure into *old*, add one *thirty-second* part, or $3\frac{5}{33}$ per cent.

" BEER MEASURE.

"The Imperial Gallon is less than the *beer*, in the proportion of 59 to 60 nearly, or as $98\frac{12}{37}$ to 100, therefore

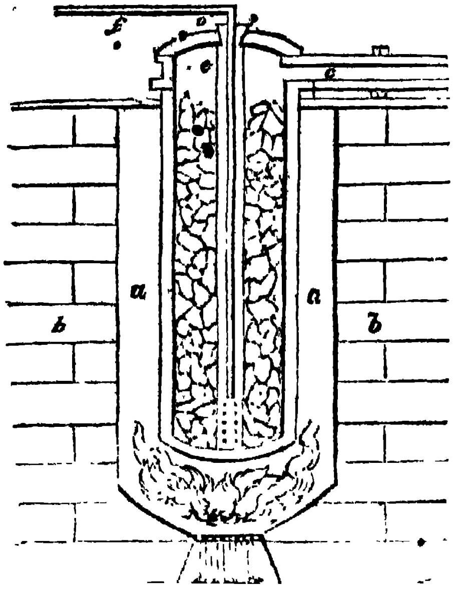
To convert *old* beer measure into *new*, add one *fifty-ninth* part, or $1\frac{31}{44}$ per cent.

To reduce *new* beer measure to *old*, deduct one *sixtieth* part, or $1\frac{25}{37}$ per cent."

To the preceding rules are subjoined a series of useful tables, calculated with considerable care, and exhibiting at one view, the exact ratio between the old and new measures, for any given quantity of wine, corn or beer, from one gallon, quarter, or barrel, to 900. A Table of Factors and their logarithms is also added, for the purpose of facilitating calculations relative to the new weights and measures; with forms for the sliding rule, adapted to the weights and measures established under the authority of the new acts.

DESCRIPTION OF THE IMPROVED PATENT APPARATUS, INVENTED BY MR. PHILIP TAYLOR, OF THE CITY ROAD, FOR PRODUCING GAS FROM VARIOUS SUBSTANCES.

The apparatus herein proposed, is designed for the purpose of distilling *carburetted hydrogen gas* for illumination from various fluids. The kind of retort proposed to be employed by the patentee, is shown in the engraving. It is placed in an erect position within its furnace, but that position is not absolutely essential.



The furnace is to be constructed as usual of fire-brick, and may contain several retorts; *b, b,* are the vertical walls of the furnace; *a, a,* the retort, which is proposed to be made of cast-iron. It is cylindrically formed, resting by means of its flanges upon ledges at the top, and the fire acts upon every part of its external surface below the ledges. Within the retort, a shell or vessel, made of thin wrought iron is inserted, exactly fitting the interior of the retort. The vessel is to contain clay, cinders, or other such materials as are fitter for the gas; and, for the conveniency of frequently and expeditiously shifting these materials, the shell or vessel is employed. In the middle of the retort, a tube, *e*, is placed, having a considerable number of holes at bottom, and into this tube a portion of the bent pipe is introduced, which passes through an aperture in the cap.

The retort being filled with broken bricks, clay, cinders, or other such substances (the largest pieces being at bottom), the cap, *o*, is to be fastened on, and properly luted at the joint. The material to be distilled is then to be introduced, in a fluid state, by the pipe, *f*, from whence it flows through the holes at bottom into the retort among the clay or cinders, which are in a state of red heat. Here the materials become decomposed, and, rising in the form of gas through the filtering substances, become clarified, and pass off at the top of the retort, through the pipe, to the gasometer or gas-holder.

If the gas produced in this manner, by passing through one retort, does not prove to be sufficiently pure, the patentee proposes to conduct it through two retorts of similar construction to that shown, and both occupied with filtering materials. In this case, however, the pipe for introducing the fluid to be distilled, may be inserted into the side of the first retort near its top, and the fluid, descending through the red hot cinders, or other filtering materials, is intended to rise in the form of gas into the central tube, through the holes at bottom, and from thence pass by a bent pipe through the cap of the first retort into a second retort, where it is to be conducted through the filtering materials, and to pass off by a pipe at the top of the retort to the gasometer.

The patentee does not confine himself to the erect position of the retorts, as shown in the figure, though he considers that position as most desirable; neither does he limit himself to the employment of iron retorts, as retorts made of fire-clay or fire-stone would answer the purpose, but he does not consider them as so convenient or economical; and, lastly, he does not specifically claim any material which shall be exclusively used for the purpose of distilling gas, but claims the employment of these means, and such apparatus for the distillation of gas from all fluid substances which are capable of producing it.

ASBESTUS.

This is a fossil of the Magnesian order, known by its *striated* or *fibrous* appearance. It may be split into threads nine or ten inches in length, of a beautiful, fine, silky texture; brittle, and of a grey colour; and which remarkable property has caused it to be employed for many important purposes. The most obvious characters of the *asbestus* are, its great flexibility, and its undergoing no change by the action of fire. This virtue was found of great utility by the ancients, for they discovered a method of weaving this singular production of nature into a sort of *cloth*. *Paper* also was made of it. The articles made of this fossil, were esteemed at a great price, and were not less in value than the finest pearls. Sig. Castagnatta, in Italy, carried the manufacture to such perfection, that his *asbestus* was soft, and, in appearance, like lambs' wool. In Venice, it was a very common occupation of the inhabitants, to spin and prepare this curious article. Table napkins were sometimes made of it, which, when soiled, were thrown into the fire to be cleaned, and which purpose was as well answered as by the usual method of washing common linen. Important documents were often written upon paper made from this material, because of its incombustible nature. But the chief use to which it was applied, was in the forming of *shrouds* for opulent and distinguished families, in which the dead bodies were closely enveloped, in order, that their ashes might be preserved in a separate state, apart from those of the wood of which the funeral pile was composed. Even in the present day, the Princes of Tartary are accustomed to use it for the same purpose. Dr. Lister tells us, that the wicks of the perpetual lamps, which were kept continually burning in the temples of Zoroaster, were formed of this indestructible fossil; even to this day, in India, it is used by Brachmans, who do not wish to be disturbed from their studies or religious duties, by the necessity of trimming their lamps. The Royal Society of London are in possession of a handkerchief made of *asbestus*, a foot long, and half a foot in breadth; and which has been submitted to the fiery ordeal; and though it is completely incombustible, yet still it loses some of its weight in the trial. The manner in which this cloth and paper is manufactured, is thus described by Ciampini:—

"The stone is laid to soak in warm water; then opened and divided by the hands, that the earthly matter may be washed out. The ablution being several times repeated, the flax-like filaments are collected and dried, and they are most conveniently spun with an additional flax. Two or three filaments of the *asbestus* are easily twisted along with the flaxen thread, if the operator's fingers are kept oiled. The cloth, also, when woven, is best preserved by oil from breaking. On exposure to the fire, the flax and the oil burn out, and the cloth remains pure and white."

Asbestus differs from *amianthus*, a fossil which it much resembles, in its being still more flexible, and easy of separation into fibres. There is a sort of asbestus known by the name of *mountain cork*, the fibres of which are twisted in various directions; when pure, it is of a white colour. The specific gravity of this fossil, is from 2.5, to 3.0. Its component parts are *iron*, *siliceous earth*, *magnesia*, *calcareous earth* and *alumina*, in various proportions, of which, *silex* forms by far the greatest part. It is found in Tartary, in Egypt, in Flanders, the islands of Corsica and Elba, France, England, and many other parts of the globe.

LUTHER.

Islington.

DISSOLVING COPAL.

Many of your readers may not be aware that the tedious proces of dissolving *copal* in spirits of wine, is rendered both easy and expeditious, by adding *camphor;* thus, dissolve *one ounce* of camphor in a *quart* of alcohol, or spirits of wine; put the solution in a circular glass, and add eight ounces of copal in small pieces, set it in either a sand bath or hot water, the heat of which is so regulated that the bubbles which arise from the bottom may be counted, till the solution is completed. This process will dissolve more copal than the menstruum will retain when cold; the most economical method will therefore be, to set the vessel which contains the solution by for a few days, and when it is perfectly settled, to pour off the clear varnish, and leave the residuum for a future operation.

Rye. TYRO.

AGRICULTURE.

One of the most simple and useful discoveries in Agriculture, comprehending pasturage, is to mix layers of green, or new cut clover, with layers of straw in ricks and stacks; thus the sap and strength of the clover is absorbed by the straw, which, thus impregnated, both horses and cattle eat greedily, and thus the clover is dried and prevented from heating. This practice is particularly calculated for second crops of clover and rye grass.

QUERIES.

No. 27.

What is the simplest method of preparing the solution of mercury, used by silk dyers?

A CONSTANT READER.

No. 28.

What is the best method of extracting oil or grease from white or coloured kid gloves?

A CONSTANT READER.

No. 29.

To the Editor of the Mechanics' Register.

SIR,—Can any of your correspondents favour me with the reasons why Sheldrake's inclined-plane wheels were not more known, and what their defects in practice or formation are?

S. E. ASH.

No. 30.

How to prepare parchment for painting?

Rye. TYRO.

ANSWERS TO QUERIES.

QUERY, No. 22, Vol. III. Page 108.

DENTIFRICE.

Charcoal is a most excellent toothpowder, but it may, perhaps, be more actively employed along with the following ingredients.—Take half a drachm of tartar of vitriol; the same quantity of myrrh; also of dragon's blood: to these add one drachm of gum lac, and four grains of ambergris, with two grains of musk, and fine powdered charcoal equal to the whole. Beat them into a very fine powder, and keep in a phial close stopped. To use it, take a fine linen cloth, wetted, on the end of your finger, dip it into the powder, and apply it well, once a day, for a fortnight; after which, twice a week will be sufficient to preserve the beauty of the teeth, and to correct any unpleasant savour from the breath, even where there is a carious tooth.

And now a few words with respect to *acids*. Teeth are composed almost entirely of *carbonate of lime*, with a small proportion of *animal matter*, and a much smaller of *phosphoric acid*; and their enamel, which is of the same nature as ivory, consists, almost entirely, of *phosphate of lime*, with a small proportion of *animal matter*, and scarcely any, if any, *carbonic acid* whatever. Now, by looking at the tables of elective attraction, we find four acids, which precede the *phosphoric* in their affinity for *lime*; the *oxalic*, *sulphuric*, *tartaric*, and *succinic*; therefore, these ought to be sedulously avoided; hence, *cream of tartar*, which enters so generally into the composition of dentifrices, should likewise be rigidly proscribed. Indeed, when teeth are deprived of their enamel, all the weaker acids should be abstained from, as they have a greater attraction for *lime* than the *carbonic*.

TYRO.

Rye.

TO CORRESPONDENTS.

F. C. must excuse the non-insertion of his Letter. Too much asperity has already been displayed during the discussion; and, as his Letter is not intended to convey any additional information on the matter in dispute, its insertion cannot answer any beneficial purpose. Without intending the slightest disrespect to F. C. for whose intelligent communications on many subjects of practical utility we owe him our best thanks, we must again express our dislike to the style of argument which he has adopted upon this occasion; because we are disposed to think that scientific argument derives additional keenness from urbanity of manners. If it were necessary to our personal welfare that we should undergo the amputation of a leg or an arm, we had rather the operation should be performed with a *knife* than with a *saw*; and if a mistaken opinion, instead of a limb, required removing, a smooth process would be much more agreeable to us than a rough one. In either of the former cases, our *feelings* would not be so sensibly affected, and we should, in all probability, escape *mortification*. These remarks are not exclusively addressed to F. C. as they are equally applicable to the communications of some other valuable correspondents. We trust they will be attended to, and that, in future, we shall be spared the pain of perusing letters, such as we have recently received from several of our Subscribers, in reprehension of the personalities alluded to.

JUVENIS ADMIRATOR will be attended to in our next Number; but, for the reasons above stated, we cannot insert the whole of his communication.

We have received several Letters from persons residing in the Borough of Southwark, expressing an anxious wish for the establishment of a Mechanics' Institution in that district. To accomplish this desirable object, we would recommend a personal application to the principal manufacturers, tradesmen, and other inhabitants; which plan has been successfully adopted at Rotherhithe, Hammersmith, and other places, and could hardly fail of succeeding in the present instance.

Answers to other Correspondents in our next.

ERRATA.

In the Letter on "Laws of Motion," in our last Number, page 156, col. 1, line 32, for "position," read "composition." Page 158, col. 2, line 30, for "leg," read "peg."

THE LONDON

MECHANICS' REGISTER.

> "A man's genius is always in the beginning of life as much unknown to himself as to others; and it is only after frequent trials, attended with success, that he dares to think himself equal to those undertakings, in which those who have succeded have fixed the admiration of mankind."
>
> HUME.

No. 68.] SATURDAY, JANUARY 7, 1826. [Price 3*d.*

MR. CROSLEY'S PATENT APPARATUS FOR MEASURING LIQUIDS.

Fig 1

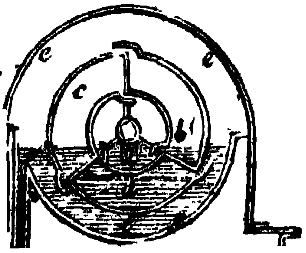


Fig 2.

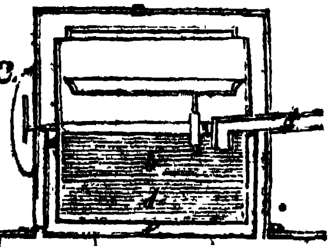
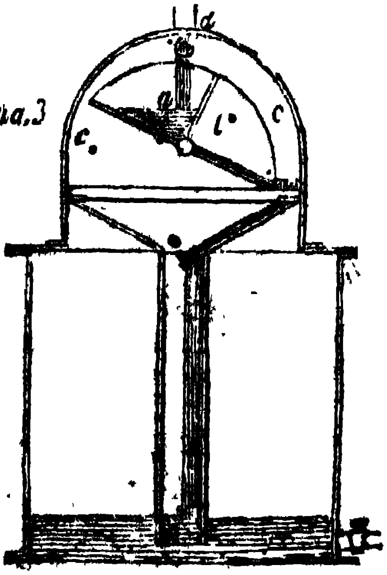


Fig. 3



MR. CROSLEY'S PATENT APPARATUS FOR MEASURING LIQUIDS.

THE apparatus, represented in the frontispiece to the present Number, is called by the Patentee a *liquid-meter*, and is intended to measure the quantity of water, or any other liquid passed through it from one vessel or elevation to another. The specification exhibits two methods of constructing it, which are susceptible of variations in their forms.

Fig. 1, is a box, containing the measuring apparatus shewn in section, which consists of a hollow drum, revolving upon its axis; this drum is divided into several compartments with outlets, and may be made in the same form as the machines commonly employed for the measuring and registering of gas, called *gas-meters*. Fig, 2, is a cross section of the same, and the respective letters refer to similar parts in each.

The liquid is conducted into the measuring-wheel by a pipe, *a*, at the axis, and, flowing through the aperture into the compartment, *b*, produces a preponderating weight on one side of the drum, which causes it to revolve, and that compartment, becoming filled with the liquid, *c*, will assume its position, and then *d*, and so on in succession as the drum revolves; the liquid discharging itself at the apertures in the periphery of the drum into the lower part of the cylindrical chamber, *e e e*, from which it flows over and descends by the flat tube, *f*, into the receptacle at the bottom of the box, and is there drawn off, as may be found desirable.

The several compartments, *b*, *c*, and *d*, made of equal and known capacities, having been filled in succession so many times, the measured quantity of the liquid that has passed through the machine is registered by a train of counting-wheels, connected to the axis of the drum, with an index moving round a dial-plate, and the quantity is made known by inspection. The form of the partitions may be varied in several ways; the sides being made perfectly air-tight.

The difference between this machine and a *gas-meter* is, that, in the latter, the gas to be measured occupies the upper part of the drum, the lower being filled with water as a resistance; whereas, in the former, the liquid to be measured flows through the lower part of the drum, and the upper part is occupied with atmospheric air.

The other construction of meter for ascertaining the quantity of water or other liquid passed through it, is represented at fig. 3. It consists of a double trough, *a* and *b*, the sides of which are at right angles; this trough is placed within a box, *c c*, and tumbles over upon an axis in which it is balanced, with stops or rests on the sides of the box, to limit the extent to which the trough shall fall over on either side. The liquid to be measured flows from a pipe, *d*, immediately over the axis of the double trough, and having occupied the trough, *a*, sufficiently to cause the weight of the liquor on one side to preponderate, the trough then tumbles over to the other side, discharges its contents into the receiving vessel below, and brings the trough, *b*, up into a situation capable of receiving a similar quantity of liquor. Thus, a succession of vibrations of the trough, each time discharging an equal quantity of liquid, will determine, by a train of counting-wheels connected to its axis, and an index, the quantity of liquid that has passed through the machine.

These measuring machines must be inclosed in a close air-tight vessel, which the Patentee calls an air-vessel. "The capacity of the air-vessel must be such as to admit of sufficient compression of the air, and must, therefore depend on the extent of the pressure of the column to which the *liquid-meter* is exposed, and it must be sufficiently large to allow space for the measuring machinery to work without its being interrupted. The well known laws of compression of air, will determine the size of the vessel, adapted to any particular situation; and it is unnecessary to enter into a detail of the particular dimensions applicable to all the various cases to which apparatus of this description is to be applied."

The Patentee further states, that he does "not claim originality in the construction of the measuring wheel, or drum, of the measuring trough, or in their application to the measuring of liquids, when used without the *air-ves-*

rel." But he claims "the combination of the *air-vessel* with the measuring apparatus, by which means liquids passing from one place to another from any elevation, and occasioning, therefore, any degree of pressure, may be measured and registered.—*London Journal of Arts.*

LONDON MECHANICS' INSTITUTION.

MR. GOWRING'S SECOND LECTURE ON PNEUMATICS.

DEPOSITION OF MOISTURE IN EXHAUSTED RECEIVERS—BAROMETER—WHEEL BAROMETER—SPRING, OR ELASTICITY OF AIR, DEMONSTRATED BY VARIOUS EXPERIMENTS—AIR-PUMP—AIR CONTAINED IN DIFFERENT SUBSTANCES—PRESSURE AND ELASTICITY OF THE AIR EQUAL TO EACH OTHER, &c.

WEDNESDAY, DECEMBER 28TH, 1825.

MR. GOWRING introduced his subject, by adverting to the commencement of his previous lecture, when he had observed that the principles of the science of pneumatics were few and simple, and that one of these was, that air is a body, and occupies space; and, consequently, like other matter, possesses pressure or weight. This principle he had proved, by several experiments, in the course of which he had requested the audience to observe the cloud that was formed in the interior of the receivers, as soon as the process of exhaustion commenced. He had stated, that this appearance was a proof that exhaustion was going on, and that it was occasioned by the deposition (in the form of condensed vapour,) of water, previously held in a state of chemical solution by the atmosphere. Since making these remarks, he had received a communication, which, from the signature, he presumed, came from a Member of the Institution. The letter was respectfully worded, but he regretted, in common with other gentlemen, that communications of this kind should be *anonymous;* and he also thought they should be sent to the premises of the Institution, and not to the residences of the Lecturers. Mr. Gowring then read the letter, as follows:—

"SIR,—Emboldened by the manner in which you have come forward in support of the liberal principle, of diffusing knowledge amongst this class of society, I have ventured to address you upon a circumstance, although perhaps trifling, yet one which I never heard pointed out in any lecture on pneumatics. I allude to the condensation of vapour on the interior of the glass vessels, when under the process of exhaustion. Considering that the deposition of moisture could not owe its origin to the mere mechanical action of the pump, I concluded that it must arise from some chemical action: what the cause of the action may be, I shall feel obliged by your stating. Being but a Tyro in all the subjects relating to natural philosophy, I dare not presume to offer my opinion. With considerable apprehension that the subject is not worthy your notice, I remain your's, respectfully,

M. L. M. I.

Mr. Gowring proceeded to observe that, as far as facts would warrant him, he had no objection to offer his opinion on the subject mentioned in the letter. It was stated (he believed by Dr. Henry) that the chemical proportions of 100 parts of common air were as follow:—*oxygen* 21, *nitrogen* 77 5-10ths, *vapour* 1 42-100ths, and *carbonic acid gas* 8-100ths. It appears, therefore, that every 100 parts of air contain 1 42-100*ths* parts of the vapour of water, and that this vapour is held in chemical solution there can be no doubt. Mechanically speaking, the vapour may be considered as diffused through the air, as water is diffused through a sponge. Mr. Gowring conceived, therefore, that when the support of the air is removed, by exhausting it from the receiver, the vapour becomes deposited on its interior surface; because air being a *permanently elastic fluid*, which water is not, the former is more easily withdrawn from the receiver than the latter; which, losing its support, is necessarily precipitated. How the water is held in *chemical solution* in the atmosphere, it was not his province to determine.

Mr. Gowring then again adverted to the subject of the *barometer*, to which he had alluded in his previous lecture, and introduced an additional experiment to demonstrate that the mercury is supported in the tube solely by the pressure of the atmosphere. A vessel of mercury was placed under a receiver, into the top of which was fitted a barometrical tube; its lower extremity nearly touching the surface of the mercury. The air was exhausted, both from the receiver and the tube, and the latter was then depressed till it dipped into the mercury. The air was now re-admitted into the receiver, but being prevented from entering the tube, its pressure instantly drove up the mercury to a height of more than two feet; and, if the exhaustion had been more perfect, it would have risen to 29½ inches. Upon again exhausting the vessel, the whole of the mercury fell into the basin, and as immediately rose again, when the air was re-admitted.

Mr. Gowring then alluded to the construction of the *mountain-barometer*, which is used for measuring altitudes, and which differs from the common barometer, in being furnished with a flexible bag at the bottom of the tube, to contain the mercury. From the purposes to which the mountain-barometer is applied, it requires greater nicety in its construction than the common one. The first requisite is, that the bore of the tube should be perfectly equal through its whole length; and the second, that the mercury should be purified from all foreign matter, by repeated distillation and boiling.

The Lecturer next exhibited the common *wheel-barometer*, which is so constructed that the actual rise and fall of the mercury is multiplied by an index, moving through the divisions of a graduated circle. At the equator, the fluctuation of the mercury does not exceed 3-10ths of an inch; but in this country it varies from 28 to 31 inches; and, in higher latitudes, the variation is still greater. In the *wheel-barometer* the lower end of the tube is bent upwards like a syphon, and a weight floats upon the surface of the mercury, connected with another weight, which exactly counterpoises it, by means of a line passing over a glass pulley. When the mercury rises or falls, the motion communicated to the pulley turns the pivot of the index, and thus the variation of an inch, in the height of the mercury in the tube, causes the index (in the instrument exhibited by the Lecturer) to move through about 7 inches on the graduated circle. This barometer is not, however, so well adapted for accurate purposes, as the pediment barometer in general use.

Mr. Gowring, having terminated those experiments which specifically related to the *pressure* of the atmosphere, now proceeded to illustrate its *spring* or *elasticity*, and to shew that the latter is equal to the former. The *elasticity* of the air was shewn by a variety of interesting experiments; such as the expansion of a small portion of air, contained in a bladder, when the exterior pressure of the atmosphere was removed; the escape of the air contained in a bolt-headed glass tube, the extremity of which was immersed in coloured water; and the experiment of the *fountain in vacuo*, in which the same effect was produced, by the *elasticity* of the air, as had resulted from its *pressure* in the previous lecture. Mr. Gowring also introduced a cylindrical glass vessel, partly filled with water, at the bottom of which were seen a small glass balloon, and a little figure of a man, both of which rose to the surface of the water, as soon as the air which pressed upon it, was withdrawn by the air-pump; but immediately sunk, when the air was re-admitted. This effect was occasioned by the *elasticity* of a small portion of air, contained in the balloon and the figure, which expanded when the pressure was removed; and, by expelling the water they contained, rendered them specifically lighter than the fluid in which they were immersed. In another experiment, which was both *hydrostatic* and *pneumatic*, a small bladder, nearly emptied of air, and with a weight attached to it, remained at the bottom of a vessel of water, till the pressure of the air was removed, when the small portion of air in the bladder immediately expanded, and it ascended like a balloon fully inflated, till its upper part was considerably above the surface of the water.

After some other experiments, which we have described on former occasions, Mr. Gowring gave a very distinct and satisfactory description of the construction of the air-pump; the operation of which is somewhat similar to that of a common pump, (Vide Vol. II. page 283) and depends upon the *elastic* property of the atmosphere; for so long as the *spring*, or *elasticity* of the portion of air remaining in the receiver, is sufficient to overcome the spring or tension of the silk valves employed in the air-pump, we can continue to carry on the process of exhaustion, but no longer, with a machine upon this construction. The valves are sometimes made in a conical form; but the best pump for experimental purposes was invented by Mr. Prince, of America, who substituted an air-tight cock for the valves; so that the air in the receiver had only to overcome its own friction against the pipe it passed through. The Lecturer also explained the mode of ascertaining the state of the vacuum produced by the air-pump, by connecting with the machine a barometrical tube, in which the mercury rises to a greater or less height, in proportion as the vacuum is more or less perfect.

As a further demonstration of the *elasticity* of the air, the Lecturer immersed an apple and a piece of wood in a vessel of water, and exhausted the air from the receiver under which it was placed, when innumerable bubbles of air were seen to proceed from both these bodies, rising to the surface of the water with great rapidity. It is evident, from this experiment, that air is contained in many substances where it is not generally known to exist; and also that air, though confined in a solid body, does not lose its *elasticity*. Chemists, indeed, say, that air though confined for ages, preserves all its mechanical properties.

Mr. Gowring then performed an experiment in which the effects both of the *pressure* and *elasticity* of the air were very ingeniously combined. Two phials were produced, to the necks of which were fitted glass tubes, proceeding horizontally for two or three inches, and then bending downwards at right angles. One of the phials was nearly filled with a coloured fluid, and was furnished with a valve opening inwards; the other phial was empty, and its valve opened outwards. Between these phials was placed an empty glass vessel, open at the top, in which were inserted the tubes proceeding from the two phials. The apparatus being thus arranged, was placed under a large receiver, and the air being exhausted from all the vessels except that which contained the fluid, the *elasticity* of the small portion of air remaining in this phial (and which was prevented from escaping by the valve) caused it to expand till the whole of the fluid was forced through the bent tube into the middle vessel. The air was now re-admitted into the receiver, and the *pressure* of air immediately produced a similar effect by emptying the second vessel, and driving the whole of its contents into the third.

The Lecturer having before exhibited to the audience the elevation of the mercury in the tube of the barometer, both by the *pressure* and the *elasticity* of the atmosphere, now combined the two experiments, by attaching two barometrical tubes to separate receivers, by means of the *double transferer*. The object of this experiment was to prove that the *elasticity* of the atmosphere is equal to its *pressure*; but there was evidently considerable difficulty in performing it with perfect accuracy, owing to imperceptible leakages, and other sources of imperfection in the apparatus. The result was, however, highly satisfactory; for the mercury in the tubes, driven up, in the one case by the *pressure*, and in the other by the *elasticity* of the atmosphere, reached so nearly the same altitude, that the Lecturer's position might be considered as fully established.

The final experiment was performed with a glass tube, bent like a syphon the longest leg of which measured about 9 feet. A small quantity of mercury being introduced into the tube, occupied, of course, the bend of the syphon, and confined a portion of air in its shortest leg. One atmosphere of mercury (or about 29½ inches) was now poured into the tube, when the air it contained was immediately condensed into a space, nearly one-third less than it had previously occupied. A second atmosphere was then poured in, when the air filled a space of about 5 inches; and, upon the addition of a third atmosphere of mercury, this space was reduced to less than three inches.

Mr. Gowring then observed, that having thus endeavoured to prove that the *spring* or *elasticity* of the atmosphere is, under all circumstances, equal to its *pressure*, he should, in his next Lecture, direct the attention of the Members to its *compressibility*.

MR. COOPER'S

THIRTEENTH LECTURE ON CHEMISTRY.

ALKALINE EARTHS—LIME—ITS USES IN AGRICULTURE AND BUILDING—METHOD OF BURNING IT—FLAME-BURNT LIME—CEMENTS—CARBONATES OF LIME—MARBLE—CALCAREOUS SPAR, &c.—CRYSTALLOGRAPHY—GONIOMETER, FOR MEASURING THE ANGLES OF CRYSTALS—DR. WOLLASTON'S REFLECTING GONIOMETER—PREPARATION OF PURE LIME—SLAKING OF LIME—DECOMPOSITION OF LIME BY VOLTAIC ELECTRICITY—CALCIUM—CHLORIDE OF LIME—BLEACHING POWDER—BI-CARBONATE OF LIME—SPRING WATER, &c.

FRIDAY, DECEMBER 30TH, 1825.

THE substance to be introduced to the notice of the Members this evening, observed Mr. Cooper, is the first of the four alkaline earths, *lime*, *barytes*, *strontites*, and *magnesia*. The first of these, is that substance which is most abundantly found in nature, though never otherwise than in combination with other substances, the principal of which are *carbonic* and *sulphuric acid*. The combinations of *lime* with *carbonic acid* are called, in common language, *lime-stones*, and comprehend the whole of the *chalk-stones*, though other compounds are, more strictly speaking, *lime-stones*; *chalk* being a *lime-stone* of an inferior kind. Many extensive ranges of hills, in the north of Scotland, and other parts of the world, are formed entirely of *carbonate of lime*, and, wherever it is found, its constituents are always the same; varying only as to the quantity of *water* it contains.

Lime was applied, at a very early period, to the purposes of agriculture and building; but, in agriculture, it is never used in a *caustic* state, (that is, free from *carbonic acid*;) for, in this state, instead of being serviceable to vegetation, its effect is exactly the reverse. It may, however, be advantageously applied in a caustic state to the surface of land; and, when we see it spread upon the ground by farmers, to fertilize the earth, it is used in order to destroy a quantity of vegetable matter which the soil may contain. If a soil abounds in vegetable matter, such as the roots of former vegetables in an undecomposed state, the addition of straw and lime, in a caustic state, decomposes the vegetable matter, and renders the soil fit for the food of plants. Vegetable matter being composed, in a great measure, of *carbon* and *hydrogen*, the *lime* renders it more soluble, by combining with its *carbonic acid*, and liberating its *hydrogen*. *Lime* also is found in most vegetables, by a chemical examination of the ashes of plants, and the substance must evidently be derived from the soil in which they grow. *Marles* consist of *lime*, combined with sandy and argillaceous matter.

Lime being so extensively used for the purposes of building, the method of burning it is of considerable importance. In the neighbourhood of London the process is extremely defective; the kilns are badly constructed, and the chalk employed is not of so good a quality as at other places. To burn *lime* well, it is necessary to use a sufficient quantity of fuel to get rid of the whole of its *carbonic acid*. Now in London, the expense of fuel is very great; and the materials generally used for this purpose are not good enough. The refuse of sifted ashes, &c., contain an immense quantity of impurities, and the *lime* is frequently said to be *over-burnt*, which is impossible. The fact is, it becomes *vitreous*, by combining with the impurities of the fuel, and it is, therefore, requisite, in order to burn *lime* properly, to employ good materials, and such as are free from *sulphur*, of which substance coal contains a considerable quantity; and, consequently, all the *lime* burnt in London, and its vicinity, contains *sulphur*, in the state of a *sulphuret*.

The late Lord Stanhope constructed *lime-kilns*, on an improved principle, in the neighbourhood of Seven Oaks, and entirely dispensed with the use of coal or ashes. His kilns were rectangular, and contained large masses of chalk, which supported the smaller portions placed above them. A sort of cave was formed, in which a quantity of wood was burnt, the flame from which passed through the interstices of the chalk, and the *lime* thus produced was perfectly free from *carbonic acid*. This *lime* was brought to London, and sold under the name of *flame-burnt lime*, and was found to be far preferable to common lime, both for the purposes of agriculture and building.

Lime-stone, which contains *metallic oxides* and other matters, is best adapted for the formation of *cements*. *Carbonate of lime*, mixed with a portion of the *oxide of iron* and *manganese*, forms a cement, which hardens under water. *Lime-stone* of this description, is found in considerable quantities in the blue clay of London, and at the extremity of the Isle of Sheppey, where it is collected for the manufacture of *Parker's*, or *Roman cement*, which is formed by heating this stone red hot, and then pulverising and sifting it. The constituents of this cement are *carbonate of lime*, *silica*, *alumina*, *oxide of iron*, and *manganese*, and, when mixed with a quantity of water, it hardens into a solid mass; especially if *sand* is added to it. It is necessary that all cements should contain a quantity of *sand*; for it is found, that those which contain the largest portion, not only set soonest, but become hardest. To this cause is attributed the extreme hardness of the mortar anciently used by the Romans, which is found to be less easily broken than the materials it cemented together; the mortar having contained a very large proportion of *sand*, and becoming, in the course of so long a period, again fully saturated with *carbonic acid gas*, has been converted into the same *carbonate of lime* which it was originally prepared from.

Lime, as it is usually prepared, is never sufficiently pure for chemical purposes. To obtain it in a pure state, we should select the finest white marble, entirely free from red or blue streaks (which are *oxides of iron*), and subject it to the action of heat, till the whole of its *carbonic acid* is driven off. Mr. Cooper here produced a specimen of *white marble*, which, he observed, was composed of *lime* and *carbonic acid*, in certain proportions; but the same constituents form other combinations, and produce substances which differ materially in their external appearance. A specimen of *calcareous*, or *rhombic spar*, was now exhibited, which the Lecturer said was identified with the *marble*, though their appearance was so dissimilar; which was owing only to the different states of aggregation or *crystallization* of their particles. Another specimen of *calcareous spar*, not so pure as the former, was also shewn; and Mr. Cooper stated, that one of them was brought from Iceland, and the other from Derby. There is, in fact, an immense variety of *carbonates of lime* (he believed, not less than 360), differing, not in the materials of which they are composed, but merely in the *external forms* of their *crystals*. All these various crystals are, however, simply reducible to the *rhomboidal* form, exhibited in the specimen now produced; for, if a blow be given in a particular direction, to any specimen of *carbonate of lime*, the fracture will uniformly assume this form, and no other. These natural fractures are called the *cleavages* of the crystal.

Mr Cooper here remarked that he had not hitherto alluded to the subject of *crystallography*; and, as *carbonate of lime* was the first substance that had specifically required its elucidation, he had dwelt upon it longer than he otherwise should have done. The back of the specimen of *crystallized carbonate of lime* now exhibited, indicated a certain *cleavage*, and if he could obtain a portion of refracted light, the form of its fissures would be clearly distinguishable. Upon applying the specimen of *pure calcareous spar* to the back of the other, it will be seen by the eye, that the form of the crystal is the same. Another specimen of *carbonate of lime*, from Montmartre, near Paris, was also exhibited, and was, evidently, like the others, made up of *rhomboidal* fragments. It may, therefore, be observed, once for all, that from whatever part of the world carbonates of lime may be brought, and however they may differ in their external appearance, they are all cleavable into one invariable *rhomboidal* form, and their crystals exhibit certain measurable angles.

With respect to the measurement of the angles of crystals, the Lecturer observed, that every salt, and indeed every substance, crystallizes in specific forms; the angles of which are determinable by an instrument, called the *goniometer*. The French *goniometer*, which was now produced, consists of a semi-circular graduated arch, to which are attached two pieces of metal, opening from a centre; and the crystal being adjusted to these moveable pieces of metal, the angle is indicated by the situation of one of the moveable legs on the graduated arch. The *acute* angle that may be formed is, of course, less than 90°, and the *obtuse* angle greater; and the sum of the two angles must be 180°. Mr. Cooper here measured the angles of one of the *rhomboidal* crystals of carbonate of lime, which he had previously exhibited, and the *goniometer* indicated that the angles of the *rhomboid* were $101\frac{1}{2}$°, and $78\frac{1}{2}$° respectively. This instrument is, however, only calculated for large masses of crystal; and, from the difficulty of exactly applying their planes, it is almost useless.

The most perfect instrument of this description is Dr. Wollaston's *reflecting goniometer*, which is capable of measuring with the greatest precision the angles of the most minute crystals. The excellence of this instrument can only be appreciated by those who know how to use it, and the manner in which it is applied is very difficult to describe. The Members will observe, that a small crystal is attached, with wax, to the extremity of the axis of the instrument; but this crystal is of giant size, compared with those which can be accurately measured by this goniometer. The crystals to be measured by it should not, in fact, exceed 1-20th of an inch in length, by 1-100th in breadth. From the Lecturer's own experience, it appeared, that considerable practice was necessary before it could be used with perfect correctness, though no difficulty exists, when once the mode of applying it is clearly comprehended. The angles are measured by reflected light, and it is necessary to approach the eye close to the minute crystal, noticing the direction of the ray of light which falls on its upper surface, and observing the line in which it intersects some other objects, such as the bar of a window, the back of a chair, the skirting-board of a room, &c. The crystal is then moved carefully round upon the axis of the instrument, till the next surface of the crystal exactly coincides with the same objects, and the exact angle formed by the two surfaces may then be read off, by inspecting the graduations on the edge of the instrument. It is advisable, in using Dr. Wollaston's goniometer, to practice, in the first instance, with crystals whose angles are known, and, in a few days, the difficulty will be overcome.

Mr. Cooper now proceeded with his description of the mode of preparing *pure lime* for chemical purposes. He had already stated that the *carbonate* employed (marble for instance), must be deprived of the whole of its *carbonic acid* by heat. It was unnecessary for him to go through the process, which would occupy considerable time to do it well. Other substances besides marble may be employed for this purpose, such as *oyster-shells*, which must first be deprived of their *neutral salts* by boiling, and then burnt by a charcoal fire, to avoid the *sulphur* generated by the combustion of coal or coke. Another method of procuring *lime*, is by precipitating it from its solution in an *acid*. Pure *lime* may be obtained in this way from *muriate of lime*, but for the ordinary purposes of chemistry, oyster-shells, or the finest white marble, will produce it in sufficient purity.

When *lime* is exposed to the action of the atmosphere, it soon falls to powder, and by imbibing moisture from the air, it becomes *slaked*; and, in the course of a long time, it combines with the carbonic acid of the atmosphere, and ultimately re-assumes the form of a *carbonate*. The action of *water* on *lime*, forms a curious, though well-known fact, and deserves a particular explanation. The Lecturer here poured *water* upon some *lime* in a vessel before him, when the usual effect took place; the water instantly combined with the lime, which remained as dry as before, and a quantity of vapour was given off, accompanied with great heat. That the *lime* had undergone a change in this operation there was no doubt, for the water had become solidified, and it was obvious that the heat given out arose from this solidification. The heat indicated by the thermometer in this experiment, was that of boiling water, or 212°; but when larger quantities are acted upon, the heat is proportionably greater. Mr. Cooper knew an instance, in which a barge, in his own neighbourhood, loaded with lime, was burnt in consequence of the vessel being leaky. In the process of *slaking lime*, the water, in passing from a *fluid* to a *solid* state, to enter into combination with the *lime*, suddenly parts with the whole of its *caloric of fluidity*, and from this cause arises the intense heat which is generated during the combination.

Lime is slightly soluble in water, in which it forms the transparent solution, called, in common language, *lime-water*. This solution possesses all the properties and characters of an *alkali* (which was exemplified by its effect on turmeric paper), and it is, therefore, evident, that *lime* combines the characteristics of an *alkali* and an *earth*. The solubility of lime depends materially on the temperature of the water employed; for it is a most curious fact, that *lime* is more soluble in *cold* than in *hot* water. Mr. Cooper believed that this was not the case with any other substance known in the science of chemistry.

Lime is infusible by the most intense heat that can be produced by a furnace. *Voltaic electricity* has, however, in some degree, fused it, and a similar effect has been produced by the *oxy-hydrogen blow-pipe* which, the Members will recollect, was recently introduced in Dr. Birkbeck's excellent optical lecture, for the purpose of producing an intense light by the combustion of lime (vide page 67). But, though lime may be said to be infusible by any heat which can be produced by ordinary means, it is extremely fusible when in contact with other earthy matter, and is, therefore, used as a *flux*, for the purpose of obtaining the metal from *iron-stone*. It is also very advantageously employed in the fusion of metals in blast-furnaces, as it forms a more fluid *clinker*, through which the pure metal percolates, and is freed from *sulphur* and other impurities.

Lime is a compound of *calcium* and *oxygen*, and must, therefore, be considered as a *metallic oxide*. For the decomposition of *lime*, as well as of *potash* and *soda*, we are indebted to the extraordinary researches of that eminent chemist, Sir Humphry Davy, and from his calculations, and those of Berzelius, the proportions in which its constituents unite have been ascertained. Mr. Cooper here referred to the great scale of chemical equivalents, and shewed, that *lime* stood opposite the number 28, which indicated its combining weight, while *calcium* and *oxygen* appeared respectively against the number 20 and 8. There is, however, another compound, containing a larger portion of *oxygen*, which is called the *peroxide of calcium*; this *second oxide* is formed by causing a stream of *oxygen* to traverse *red-hot lime*, but the substance is not of importance, and is merely mentioned as a chemical fact.

If a quantity of *lime* be placed in an exhausted retort, and the vacuum be filled with *chlorine*, by heating the lime in contact with this gas, the result will point out the proportions in which the constituents of *lime* combine; for the chlorine will enter into combination with the *metallic base* of the *lime*, while its *oxygen* will be given off, and will supply the place of the *chlorine*. By knowing, therefore, the exact quantities of the substances employed, the relative proportions of the constituents of *lime* may be correctly estimated. Mr. Cooper performed this experiment by heating *lime* in an atmosphere of *chlorine*, in a retort; but the decomposition of the *lime* was unaccompanied by any perceptible change, though he observed that, upon examining the result, it would be found, that *chloride of calcium* had been formed, and the *oxygen* of the *lime* set at liberty. In the scale of equivalents, the combining weights of the different substances appeared as follows:—*calcium* 20, *chlorine* 36, *chloride of calcium* 56.

Chloride of calcium may also be formed, by treating *lime* with *muriatic acid*, the result of which is *muriate of lime*, which, like all other *muriates*, becomes decomposed by subjecting its crystals to a red heat. *Water* is then formed by the union of the *oxygen* and *hydrogen* of the muriate, while the *chlorine* combines with the *calcium*, and forms *chloride of calcium*. The chloride is very useful in producing extreme dryness in gases used for chemical experiments, for its affinity for water is so great, that if introduced into any gas containing the slightest trace of moisture, it combines with it, and leaves the gas sufficiently pure for determining its specific gravity, and for other purposes.

Chlorine, in combination with *lime*, forms a substance extremely useful to manufacturers, called *bleaching-powder*. This compound is prepared exactly in the same manner as *chloride of potash*, keeping the vessel agitated, to prevent the *lime* from settling, and to expose a greater surface to the action of the *chlorine*. In purchasing *bleaching-powder*, it is necessary to ascertain whether it is of a certain standard strength; not only that the buyer may have his money's worth, but also that he may be certain the preparation will not deteriorate the articles to which it is to be applied.

Bleaching-powder is partly soluble in water, for that portion which is chemically united to the chlorine will dissolve, while that part which is not saturated with the gas will remain insoluble. As, however, it contains a quantity of *muriate of lime*, which is also soluble in water, this process is not a test of its strength. The most satisfactory test is a *solution of indigo* of a certain known strength; for if we can once ascertain that a certain quantity of genuine *bleaching-powder* will destroy the colour of a certain quantity of *indigo* in solution, we are furnished with a complete test of the value of the article in question. Mr. Cooper here gently poured into a solution of *indigo*, a small quantity of a solution of *chloride of lime*, from a graduated tube; when the deep blue colour of the indigo was totally destroyed, and the tube indicated the quantity of *chloride of lime* required for that purpose. It is, therefore, only necessary to know the precise quantities of the two substances employed, in order to determine, at once, the strength and value of the *bleaching-powder*.

While upon this subject, Mr. Cooper availed himself of the opportunity of adverting to a note which he had received from a Member, inquiring "what *quantity of sulphuric acid* neutralizes one hundred grains of pure alkali; the word *measure*, used by Mr. Cooper in his experiments in alkalimetry, not conveying the idea of any *definite quantity* to his mind." The Lecturer felt obliged to the writer for reminding him of his oversight, in not having been sufficiently explicit upon this subject, and, in reply to the question, he would consult the oracle, or the scale of chemical equivalents. In this scale, *carbonate of potash* (in a dry and pure state), stands opposite 70, while *sulphuric acid*, or *oil of vitriol* is opposite 49. It is, therefore, evident, that 49 parts of *oil of vitriol* by weight will saturate, or neutralize 70 of *carbonate of potash*. Now, to ascertain the quantity of the former necessary to neutralize 100 grains of the latter, the scale has only to be shifted till *carbonate of potash* coincides with 100. This was accordingly done, and *oil of vitriol* was then on a level with 70. If, therefore, we weigh 70 grains of *sulphuric acid*, and, after introducing it into the tube, which is graduated into 100 parts, add water till the tube is filled, we shall find that this solution of *sulphuric acid* will exactly neutralize 100 grains of the *carbonate;* and as the 70 grains of *oil of vitriol* will neutralize the whole, the quantity contained in each division of the tube will neutralize one grain.

It has been already stated, that *lime* combines with *carbonic acid gas,* and this combination takes place by its exposure, either to the atmosphere, or to any other substance containing *carbonic acid.* A vessel of *lime-water* was now placed before the Lecturer, and a quantity of *carbonic acid* was driven into it by a forcing-pump, when the *lime-water* lost its transparency, and assumed a turbid and milky appearance, owing to the precipitation of the *lime* it contained. But there are two combinations of lime and carbonic acid, viz., the carbonate and the bi-carbonate; and if we go on injecting more of the gas into the lime-water, for a considerable length of time, its transparency will be restored; the *lime* being again held in solution by excess of *carbonic acid.*

It is in this state, that *carbonate of lime* is held in solution in *spring-water.* It is well known, that when common spring-water is exposed to the action of heat, long before it reaches the boiling temperature, a quantity of gas (which is *carbonic acid*) escapes, its transparency is destroyed, and a considerable precipitation takes place. Mr. Cooper exemplified this fact by boiling some spring-water in a flask, and observed that, in this case, the lime is precipitated, because, owing to the escape of *carbonic acid,* there is not a sufficient quantity left to hold it in solution. This is the source of the deposition which takes place in steam-boilers; for the *carbonic acid* being driven from the water by heat, the *lime* which was held in solution is precipitated, and constitutes the fur, or scales deposited in the vessels.

Spring-water may be rendered *soft* by the addition of any substance which will deprive it of its *carbonic acid.* In neighbourhoods where the water is excessively hard, the best way of softening it, is *to take away the lime it contains by adding more lime to it.* This may appear paradoxical, but it is actually the fact; for the extra portion of *lime* deprives the water of its *carbonic acid,* and, at the same time, both the portions of *lime* are precipitated. The same effect may be produced by the addition of an *alkali,* which unites with the *carbonic acid* that was held in solution, and, consequently, precipitates the *lime.* This method is, however, much more expensive than the former, for about two gallons of *lime-water,* are sufficient to soften the whole of the water in a large tank.

Mr. Cooper concluded his very able and instructive lecture, by stating, that there were some other substances, connected with *lime,* the consideration of which he must defer till the ensuing Friday evening.

Dr. Birkbeck then announced to the Members that, as the large apartment beneath the Theatre was now completed, Mr. Black. jun., would, on Thursday, the 5th of January, commence the instruction of a Class of 120 pupils, in the French language. To complete this extensive class, the names of the Members standing first on the list of applications would be taken; and those Members would receive due notice, by a letter from the Secretary. He had also to state, that the number of pupils in the Drawing School would be increased, for the same reason, though the arrangements for its extension were not, at present, equally complete. Mr. Davy, the Teacher of Drawing, could not, as yet, undertake to give instruction to so large a class; but ten more pupils would be added to the number now in the school, which would be progressively enlarged, by the addition of ten pupils at a time, till the room was filled.

The worthy President's gratifying communication was received with loud applause, and the meeting then adjourned.

LECTURES FOR NEXT WEEK.

Wednesday, January 11th, Mr. Gowring's Fourth Lecture on Pneumatics.

Friday, January 13th, Mr. Cooper's Fifteenth Lecture on Chemistry.

CORK AND DUBLIN MECHANICS' INSTITUTIONS.

The Second Quarterly Meeting of the Cork Mechanics' Institution, was held at the Mechanics' Hall, on Wednesday week, when it appeared that the amount of subscriptions and donations that had been received, was 1,839l. 11s. The disbursements were 910l. 19s. 2d., and the balance on Government Debentures was 1,028l. 11s. 10d. A General Meeting of the Dublin Mechanics' Institution was held on the same day, when the statements laid before the Members, relative to the progress of the Institution, were of the most satisfactory nature.

OBSERVATIONS ON MR. GORDON'S THEORY OF THE THUNDER-STORM, &c.

To the Editor of the Mechanics' Register.

Sir,—Amid the wide field of conjecture in which we are placed, relative to the different phenomena which take place in the atmosphere, there is no want of theories; and the only thing we can do, in this state of uncertainty, is to adopt that which may appear the most reasonable, and carry with it the greatest degree of probability.

Your correspondent R. D. G. in your last Number, page 169, adopting Mr. Gordon's theory of the explosion of *hydrogen gas*, to account for these phenomena, differs from that gentleman as to the source from which the *hydrogen* is supplied for that purpose. He (or rather the lecturer Mr. H., to whom he ascribes the merit of the theory) supposing it to be derived from the *nitrogen* of the atmosphere, which, instead of being a simple element, he says is now found to be a compound of *hydrogen* and *oxygen* existing in the state of *oxide of hydrogen*, and which, when floating in higher regions, in consequence of the diminished pressure of the atmosphere there, and the deficiency of heat, from the radiation of the earth, undergoes a partial decomposition, and is, in that state, capable of explosion.

Dr. Priestly, I believe, was the first who, in distilling water in *earthen* retorts, or through *earthen* tubes, at a high temperature discovered that a great quantity of *nitrogen gas* was liberated, notwithstanding the water had been previously freed from atmospheric air by the action of the air pump. But he afterwards found that on using *glass* or *metallic* tubes, none was formed; therefore he supposed that, in the former case, it was owing to the porosity of the tubes admitting the atmospheric air. Gertumnu, however, repeating the latter experiment with the glass tubes, in which a little clay, lime, or siliceous earth was placed, said he succeeded in producing *nitrogen gas;* and Van Humboldt, and others, found that earths, when moistened, absorb *oxygen* rapidly at a high temperature, which led to the supposition of *nitrogen* being a compound of *hydrogen* and *oxygen*, which, in this case, is obtained from the water. Sir Humphrey Davy, more recently, has discovered, that in the action of *potassium* on *ammonia*, *nitrogen* can be made to disappear, or be regenerated; so that when it disappears, nothing is obtained in its place but *oxygen* and *hydrogen;* and when it is formed, its elementary matter is furnished by water, and on these data the *compound* nature of *nitrogen* at present rests.

With respect to *nitrogen*, however, in its natural state, we know that it is neither a supporter of combustion, nor capable of being exploded; but if, under the circumstances stated by R. D. G, it is possible to be done, the fact may be easily ascertained by that gentleman, or other of your correspondents, who will take the trouble, by a very simple experiment, viz. filling a jar with the gas, inserting it in a freezing mixture, and then firing it by passing an electric spark through it; for in this experiment we should have all the circumstances R. D. G. contends for in an elevated region, viz. a diminished temperature, and being altogether freed from atmospheric pressure. If this succeeds, it may do something towards establishing the theory, but still we do not find that electric clouds, by which the phenomena are produced, ever float in very elevated regions of the atmosphere; and that, instead of a diminished temperature being found there at such times, it is greatly increased, until after the escape of the electric matter, when the air is immediately cooled.

In my last letter, opposing Mr. Gordon's theory, I think I must have made it plainly appear, that in two of the phenomena, at least, viz. the whirlwind and water-spout, the vacuum could not be produced by the explosion of *hydrogen gas;* as in general they are unattended by the noise of thunder, which he attributes to such explosion; and, with your permission, I will hazard a conjecture, reasoning from the facts as they take place, in what manner they are likely to be produced.

Taking it for granted, *à priori,* that they never take place at night, during the absence of the sun, and only in very hot weather, or in tropical climates (which I believe is correct) I seek for the cause in the intensity of the sun's rays, which, acting on certain watery particles floating in the air, suddenly expands them, forcing back the circumambient air, to which it communicates a *spiral,* or *rotatory motion;* that the elastic vapour coming in contact with this current, becomes again suddenly condensed, which produces a vacuum; and that this latter is preserved and not broke in upon, in consequence of the rotatory motion which the air surrounding it has acquired; the particles of which the latter is composed continuing to press on each other only in that direction. The form of the vacuum, owing to this motion, we find is ordinarily of a funnel shape, the smallest extremity resting on the earth's surface. When this takes place upon land, what is termed a *whirlwind* is produced; tearing up trees by the roots, and, in its track, taking up sand, stones, and other ponderous substances into the air; and when it occurs on water, we have then the phenomenon of the *water-spout;* water being taken up into the vacuum in like manner, and which enables us then to see the form it has assumed, which is usually that before stated. So long only then as the rotatory motion given to the air continues, will the vacuum be preserved, which we find lasts for but a very short period; and if we can, by artificial means, produce a concussion on the atmosphere, that will break in upon it, the same will be destroyed, and the contents which it bore up with it will come instantly down: a fact which mariners have discovered, for their own preservation; as it is usual with them, on seeing a water-spout approach towards a ship, to fire a gun, the concussion of which disturbs the air, and makes it discharge its contents, before reaching her, which otherwise, did it fall upon her, would, in all probability, stave in her decks, and, perhaps, sink her.

I do not see much objection to this theory of these phenomena: and if you think it worth insertion in your columns, it is at your service. I have the honour to remain,

Sir,
Your very obedient servant,
Leigh Street. G. H.

EGYPTIAN MUMMY.

The Second Part of the "Philosophical Transactions" for 1825, contains an interesting description of an Egyptian Mummy, which was presented to Dr. Granville by Sir Archibald Edmonstone, who purchased it at Gournon, on the 24th of March, 1819, from one of the inhabitants of the sepulchral excavations on the side of the mountain, at the back of which are the celebrated tombs of the Kings of Thebes.

It was contained in a case of sycamore wood, highly coloured externally, and varnished, with many hundred symbolic, or hieroglyphic figures painted on it, and having at one of its extremities (the upper one, as the case is made to stand on its feet) the mask of a female of a middle age and rather handsome. The Mummy was covered with bandages and square pieces of cloth, very skilfully arranged, and applied with a neatness and precision that would baffle the imitative power of the most adroit surgeon of the present day. These were repeated so many times, that when removed, the whole mass of them was found to weigh 28lb. avoirdupois. Dr. Granville ascertained that the bandages consisted of linen, as well as cotton, and that they had previously been tanned.

These envelopes being removed, it became at once apparent that the Mummy was that of a female, and in the most complete state of preservation, possessing softness, with the firmness of muscles, mobility in the articulations, and a peculiar character of beauty in its general form. The dimensions of every part of this Egyptian female, compared to those given by writers on the Fine Arts, of the Venus de Medicis, show her to have differed but little from the latter in configuration. In the same manner Dr. Granville has shown, by means of comparative measurements, that the female in question does not belong to the Ethiopian or Negro race, but approaches the nearest to the *beau ideal* of Caucassian structure. This is the first time that we have had a good opportunity of fixing our ideas respecting the conformation of the Egyptian women who lived anteriorly to the building of the Pyramids.

We shall only state further, that, in the course of a minute dissection of this female, the doctor was enabled to bring into view almost all the viscera; that he has endeavoured pretty nearly to fix the age at which she died; shown that she had borne children; and made it manifest, that she fell a victim to ovaria, or dropsy. The different parts of the dissected Mummy, in support of his various positions, were submitted by Dr. Granville to the inspection of the Fellows, after the meeting of the Society. The seat of the disorder which caused her death—namely, the womb, attracted considerable attention, as forming the most ancient preparation of that disease now in existence.

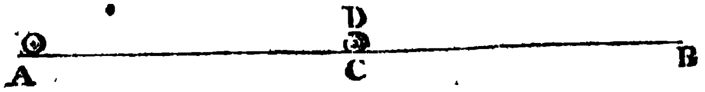
It appears also from this ingenious Essay, that Dr. Granville had succeeded in discovering the process by which this ancient Mummy was prepared by the Egyptian embalmers; and, in corroboration of this, we may state, that he exhibited, after the regular meeting of the Society, four different specimens of imitative Mummies, prepared by himself, each of them illustrative of one or two of the successive stages of the process of embalming detailed in the Essay; the last being intended to illustrate all the stages together; and exhibiting a close resemblance to the Egyptian Mummy itself.

LAWS OF MOTION, &c.

We have received a long letter from Juvenis Admirator in reply to N. R.'s remarks on his former communication, inserted in the present volume, page 47. In justification of his remark, that if the ball, *a*, be lifted a little out of the perpendicular, and let fall upon *b*, the latter will be propelled to a height *equal* to that from which *a* fell; Juvenis Admirator observes, "That in all *demonstrations* of experiments of this kind, the resistance of the air, and friction at the centre, are put out of the question, though an allowance is made for them afterwards." Emerson says, (Postulate 4) "We are to suppose all planes perfectly even and regular; all bodies perfectly smooth and homogeneous, and moving *without friction or resistance*, &c. &c. For though bodies are defective in all these, and the parts of matter whereof engines are made, are subject to many imperfections, yet we must set aside all these inequalities till the *theory* is established, and *afterwards* make such allowance as is proper."

Juvenis Admirator then states that he conceived all our readers would have understood that some allowance must be made for the effects of friction and the resistance of the air, and he therefore followed the example of Dr. Joyce in his "Scientific Dialogues," and of Mr. Lewis in his "Catechism of Mechanics," by omitting any allusion to these effects in his exemplification of the third Law of Motion.

With respect to the influence of *gravitation* in preventing the continued vibration of the ball, Juvenis Admirator observes, "That by the laws of Percussion on Elastic bodies, (see Rees's Cyclopædia under this head,) the force imparted from one elastic body to another, is *equal* to that which would have remained with the former, had it not struck the latter.

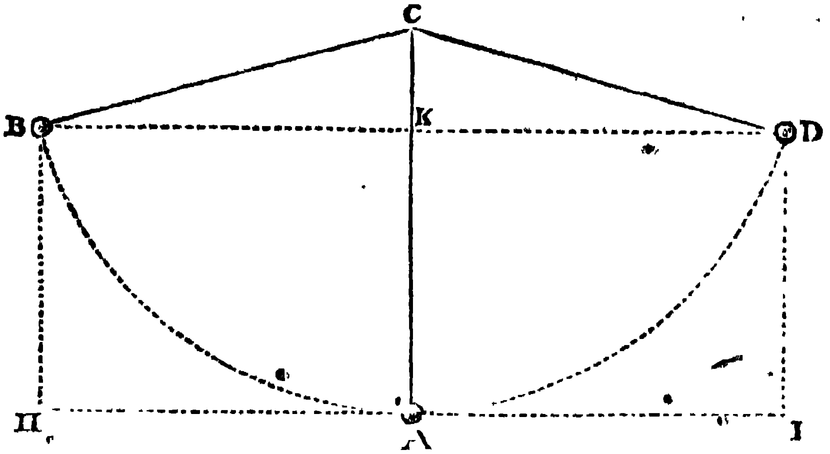


"Thus, let an elastic ball A (on the level A B) be actuated by a force sufficient to carry it to B in one second of time. Suppose that when it arrives at C, it strikes another equally elastic body D; the ball A will impart its force to D, which will arrive at B in the same space of time as A would have done from that place, had it met with no obstacle, while A will remain at C.

"The same result would have occurred, had the two bodies been suspended by threads, as in my experiment; and thus it is proved (as stated by F. M.) that 'the same effect would be produced in the case of *one ball alone*, oscillating in circular arcs,' which would be, to all intents and purposes, a *Pendulum*.

"From Rees's Cyclopædia, Article 'Pendulum,' I extract the following:—

"'Pendulum.—Any heavy body so suspended that it may swing backwards and forwards *by the force of gravity*.'



"A little further on, under 'Doctrine and Laws of Pendulums,' the following observations occur:—

"'A pendulum raised to B through the arc of the circle B A, will fall and again rise through *an equal arc*, to a point *equally high*, D: and thence will fall to A, and again rise to B, and thus continue rising and falling perpetually. For, suppose H I a horizontal line, and B D parallel to it: if the ball A (which we here consider as a point), be raised to B, the line of direction B H, being perpendicular from the centre of gravity, B, to the horizontal line A I, falls withoutside the point C; the ball, therefore, cannot rest, but must descend. But being retained by the thread, B C, from falling perpendicularly through B H, it will fall through the arc, B A; consequently, when the centre of gravity arrives at the bottom, A has the same force it would have acquired in falling from K, and will, therefore, be able to rise *equally high* as if it had; *i. e.* in descending through the first half of its vibration, it acquires a velocity by the continual acceleration of its fall; and, as this velocity is always proportionable to the height whence it falls, as being in some measure the effect thereof, it is still able to make it re-mount *to the same height;* supposing, according to the system of Galileo, that the velocities are always equal to the square roots of the heights. Since then, the thread prevents the pendulum from going off in the tangent, A I, it must ascend through the arc, A D = A B. All the force which it had acquired by falling being exhausted, it will return by the force of gravity through the same arc, A D, and again rise from A to B, and thus *continually*.'

"The writer then adds, that the resistance of the air, and friction at the centre, must be allowed for, as tending to diminish the force it acquired in falling, &c.

"Ferguson says, 'If a pendulum were put into motion in a space quite free of air, and all other resistance, and had no friction at the point of suspension, *it would move for ever;* for the *velocity* it had acquired in falling through the *descending part* of the arc, would be still sufficient to carry it *equally high* on the *ascending part* thereof.'

"Thus it is very clear, that if I could fasten my thread to the point of suspension, so as to have no friction, and put it in motion *in vacuo*, one ball would propel the other to a height equal to that from which it fell. For the resistance of the air, and friction at the point of suspension, are clearly proved to be the only impediments to its perpetual vibration, and not the power of gravitation as stated by N. R."

Juvenis Admirator concludes by intimating, that the only accusation that can be justly brought against him, is his having omitted to insert, in his answer to the query, the extract from Emerson which he has introduced at the commencement of the present letter, and which he considered it unnecessary to quote.

THE. INVISIBLE GIRL.

(From Mr. Partington's Illustrations of the Marquis of Worcester's Century of Inventions.)

No. LXXXVIII.

How to make a brazen or stone head in the midst of a great field or garden so artificial and natural, that though a man speak never so softly, and even whispers into the ears thereof, it will presently open its mouth, and resolve the question in French, Latin, Welsh, Irish, or English, in good terms, uttering it out of his mouth, and then shut it until the next question be asked.—*Marquis of Worcester.*

MR. PARTINGTON'S NOTE.

"Albertus Magnus, a celebrated philosopher of the thirteenth century, is said to have constructed an *automaton* which not only performed all the apparent motions of life, but absolutely answered questions. It is recorded of Thomas Aquinas, that, having accidentally seen the head, he was so terrified that he broke it in pieces, upon which Albert exclaimed: — *Periit opus triginta annorum!* Though this appears one of the earliest instances of a speaking automaton constructed by one of the laity, there is no doubt but that the method of conveying answers to various interrogatories, by the agency of concealed pipes or a speaking trumpet, was practised at a very early period. That the impostor Alexander, however, caused his Æsculapius to speak in this manner is expressly related by Lucan. He took, says this author, instead of a pipe, the gullet of a crane, and transmitted the voice through it to the mouth of the statue. But the invention of the *invisible girl*, which may be considered as an improvement on the oracular responses of the darker ages, infinitely surpassed any of those hitherto recorded.

"This very ingenious apparatus was exhibited both at Bristol and in London, for a considerable period, during which time no discovery was made of its internal mechanism; and it is probable that its construction would have remained a secret to all but the exhibitors, but for the ingenuity of Mr. (now Professor) Millington, who, in a course of Lectures delivered in the winter of 1806, explained the manner in which it was performed.

"The *visible* part of the apparatus connected with the *invisible girl* was thus constructed:—First, a mahogany frame resembling a bedstead, having, at the corners, four upright posts about five feet high, was united by a cross rail near the top, and two or more cross-rails near the bottom, to strengthen the frame, which was about four feet square.

"The frame thus constructed was placed upon the floor, and to the top of each of the four pillars were attached as many strong bent brass wires converging towards the top, where they were secured by a crown and other ornaments. From these wires a hollow copper ball was suspended by slight ribbons, so as to cut off all possible communication with the frame. The globe thus supported was supposed to contain the invisible being, as the voice apparently proceeded from the interior of it: and for this purpose it was equipped with four trumpets, placed round it in an horizontal direction, and at right angles to each other; the trumpets' mouths coming to within about half-an-inch of the respective cross-rails of the frame surrounding them.

"When a question was proposed, it was asked from any side of the frame, and spoken into one of the trumpets, and an answer immediately proceeded from the whole of them, so loud as to be distinctly heard by the inquirer, and yet so distant and feeble, that it appeared as if coming from a very diminutive being. In this the whole of the artifice consisted; and the variations were so contrived that the answer might be returned in several languages, a kiss might be returned, the breath producing the voice was felt, and songs were sung, accompanied by the piano-forte, &c. To produce this illusion, the sound was conveyed by a tube, in a manner similar to the old and well-known contrivance of the *speaking bust*;—the invisible girl only differing in one circumstance; that an artificial echo was produced by means of the trumpet and hollow globe, in consequence of which the sound was completely reversed.

"In the invisible girl the orifice of the tube was in one of the hand-rails just opposite the mouth of one of the trumpets, the opening being concealed by reeds and other mouldings; the tube itself, which was about half an inch in diameter, ran through half the handrail, then down one of the corner posts, and from thence under the floor till it reached a large deal case almost similar to an inverted funnel, along the side of which it rose till it came nearly into contact with the ear of the confederate, who, with a piano-forte, &c. was concealed in this case. Any question asked by a voice directed into one of the trumpets was immediately reflected back from the concave interior surface of the globe to the orifice of the tube, along which it was conveyed so as to be distinctly heard by the person in the deal case, who returned the requisite answer, which appeared to come precisely from the interior of the globe. A small hole, closed with glass, was likewise left through the deal case and side-wall of the apartment, by means of which the concealed person had an opportunity of observing and commenting upon any circumstance which occurred in the room."

QUERIES.

No. 31.

On what part of the earth can the inhabitants *first* say, that they have commenced the year 1826; supposing all to consider the day as commencing at *midnight?*

X. Y.

No. 32.

What is the easiest and best mode of cutting and grinding glass, for the lenses of microscopes and other optical instruments, and what sort of glass should be used?

H. D.

Reading.

No. 33.

Sir,—Being about to embark for Bogota, in Columbia, with my wife and family, at the middle of the present month, I shall feel obliged to any of your Correspondents who can inform me, how I can keep bread moist during the passage?

An Old Subscriber.

No. 34.

What is the best method of preparing the common solid phosphorus?

J. W—s.

TO CORRESPONDENTS.

Will a **Juvenile Philosopher** inform us where we can address a note to him? We regret that, for reasons with which he cannot be unacquainted, we are compelled to decline the insertion of his Letter in its present form.

A **Constant Reader** will find answers to his Query in our Second Volume, pp. 80, 178.

A Member of the London Mechanics' Institution will obtain all the information he requests by applying at the Portable Gas Company's Works in Little Sutton-street.

W. W.'s communication will be inserted in an early Number.

We shall have no objection to insert J. W.'s Inquiries on Ventilation, if he will put them in a different form. The mode in which he has introduced them is rather too fanciful.

We hope to be able to comply with the request of J. Q. and W. B., but it is a matter of some difficulty.

H. **Campbell** will see that our opinion coincides with his own, on the principal subject of his Letter; and, therefore, he may very safely transmit the communications to which he alludes.

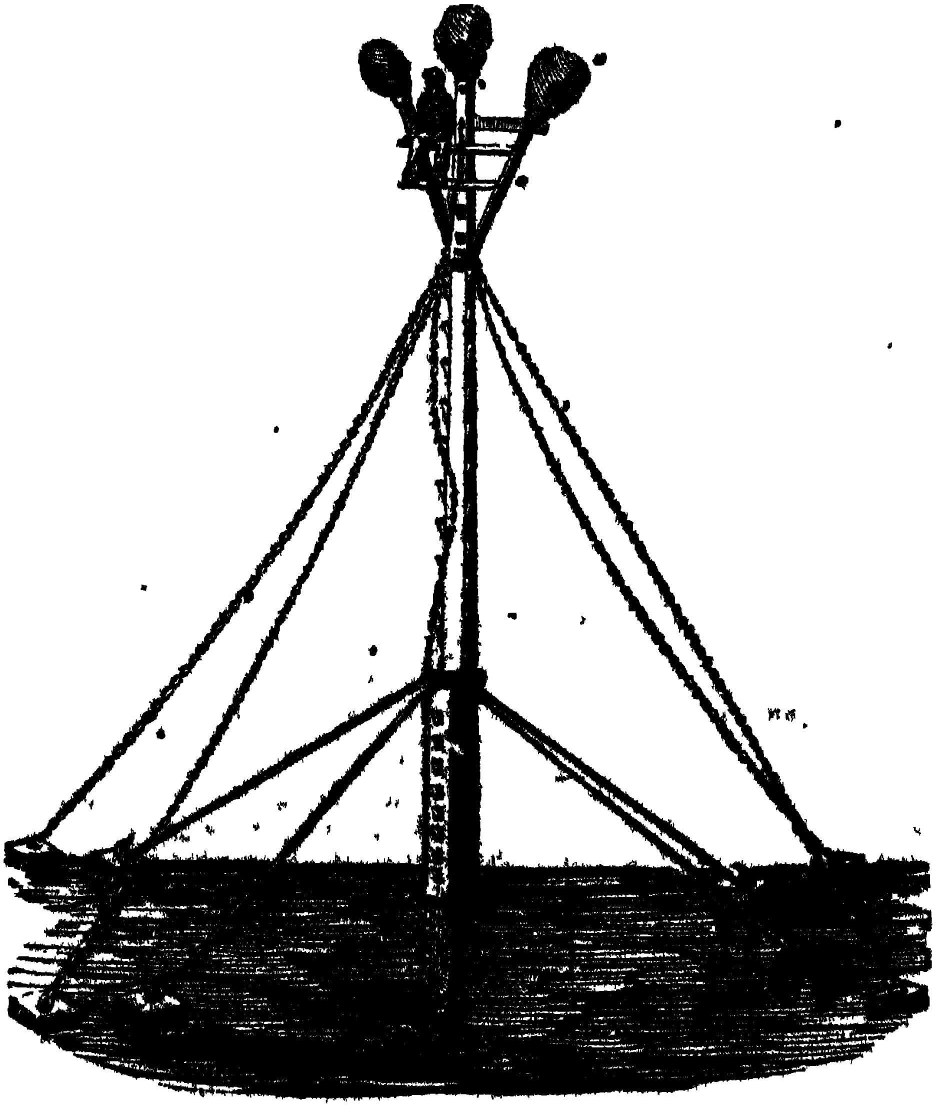
THE LONDON

MECHANICS' REGISTER.

> "Aim at perfection in every thing, though in most things it is unattainable; however, they who aim at it, and persevere, will come nearer to it, than those whose laziness and despondency make them give it up as unattainable."
>
> CHESTERFIELD.

No. 69.] SATURDAY, JANUARY 14, 1826. [Price 3*d*.

MR. HOLDITCH'S LIFE BEACON.



MR. HOLDITCH'S LIFE-BEACON.

The following account of the circumstances which led to the construction of this LIFE-BEACON, with the description of the apparatus, is given by Mr. HOLDITCH, Keeper of the Buoys and Beacons at the Port of Lynn, in Norfolk, in his communication to the Society of Arts, by whom he was rewarded with the large Silver Medal, and Ten Guineas.

"In the year 1812, the channel leading to and from the port of Lynn, altered about five miles to the westward, which brought the ships, in their course up and down this navigation, near a sand called the Longsand, which is very steep, and about six miles from the nearest shore. This caused a general wish from the shipmasters of the port to have a beacon placed upon this sand, if possible. A petition was accordingly drawn up and presented to the corporation of Lynn, requesting them to bear the expense of the same, which they readily granted.

I immediately set about the work. In the first place, a ten-inch square main-piece was driven into the sand twelve feet, with a topmast 36 feet above the level of the sand, and four posts were driven seven feet into the sand for brace-posts; but as soon as there was a heavy sea from the eastward, and a gale of wind, the motion of the braces shook the posts entirely out of the sand. I then secured the braces by heavy stones let into the sand, which held firm until the heavy gale of wind, March the 2nd, 1820, when the whole was washed down.

In July, 1820, I erected another beacon, the model of which accompanies this statement, and which, from its having remained uninjured to the present time, shows, that the imperfections in the construction of the first beacon have been successfully avoided.

The main-piece is a tree of English oak of the best quality, 27 feet long and 12 inches square, shod with iron for four feet, and for five feet above filled close with scuppers (short large-headed nails). It was bound round at its upper end with three strong iron hoops, to prevent it from splitting, and being thus prepared, was driven about 16 feet into the sand, by means of a crane and beetle of 13 cwt.

The topmast is made of a good redwood spar, 37 feet long, and tapering off from 12 inches, its diameter at its base, to 6½ inches, its diameter at the top. It is secured to the main-piece by two stout iron clasps and screw-bolts; and to the upper of these clasps are fixed four rings or eyes, to serve as the attachment of as many bars of iron, 1½ inch square, and 28 feet long. The lower end of each bar is bolted to a flat block of stone weighing 6 cwt. The stone is buried in the sand, and in a month or two gets so firmly embedded by the tremulous motion impressed by the sea on the shaft, that it would form a secure mooring for a vessel of 100 tons.

A similar iron clasp, with eye-bolts, is fixed round the topmast, about eight feet from its summit, and to this are attached four chains, each having a block of stone of 4 cwt. at the other end. These stones, like the others, soon get buried in the sand, so as to keep the chains in a state of tension, and consequently give additional support to the beacon. Just above the upper clasp are three short spars, forming an inverted triangle, for the purpose of supporting more firmly the seats which are fixed to the topmast, each piece being terminated by a head of light basket-work, in order to render the beacon more conspicuous. From the seats down to the bottom of the shaft, are cleats, by which, with the assistance of a chain for a man-rope, a sailor or other person may easily ascend to the top of the beacon.

The beacon is erected on the highest part of the Longsand, so that, even in thick weather, persons who may be upon the sand will naturally, as the water rises, be directed to it. Nor is this matter of mere speculation; for three weeks after it was erected, two men belonging to his majesty's surveying brig, Protector, lost their way in a fog on this very sand, and were preserved by retreating before the advancing tide till they arrived at the beacon.

The distance from which it is visible in clear weather without a glass, is about seven miles; it being seen from

Boston and Lynn Knock buoys to the N. E., from Humstanton cliff to the S., and from buoy No. 2, in Lynn well to the W.

The utility of such a beacon on islands of sand which are covered at high water will, I trust, induce other corporations to erect them in suitable places within their jurisdiction.

The average expense of such a beacon on a sand like ours, seven feet above low water mark, would be about £.80.

Reference to the Engraving.

Fig. 1 represents the life beacon, consisting of the main-piece, secured by two clasps to the topmast, with the iron bars and large blocks of stone, and the iron chains and smaller blocks by which the beacon is prevented from being forced out of the sand. It also shows the cleats, the man-rope, the seats on the inverted triangle, and the basket-work heads by which it is terminated—the whole being on a scale of one-twelfth of an inch to a foot.

Fig. 2 is a lateral elevation of the upper part of the topmast, showing the seats, the man-rope, and the iron clasp to which the four chains are fixed.

Fig. 3 is a plan of the clasp to which the four iron bars are attached.

Figs. 2 and 3 are on a scale of ¼ of an inch to a foot."

LONDON MECHANICS' INSTITUTION.

MR. GOWRING'S THIRD LECTURE ON PNEUMATICS.

FURTHER REMARKS ON THE BAROMETER—COMPRESSIBILITY OF AIR—VARIOUS EXPERIMENTS, ILLUSTRATIVE OF THIS PROPERTY — AIR-GUN — IMPROVED FORCING-PUMP—FIRE ENGINES—DIVING-BELL—OBSERVATIONS ON THE WINDS, &c.

WEDNESDAY, JANUARY 4TH.

Mr. Gowring having, in his preceding lecture, illustrated, by a variety of experiments, the pressure and elasticity of the atmosphere, now proceeded to speak of its *compressibility*; prior to which, he observed, that, in mentioning the application of the *barometer* to the purpose of measuring altitudes, he should have stated that, in ascending a mountain, a fall of 1-10th of an inch indicates an elevation of 100 feet. This, however, is merely stated as a general rule, for there are many rules to be observed, and a variety of circumstances to be considered, in order to measure altitudes with accuracy, by means of the *barometer*. Mr. Gowring also referred to a diagram, for the purpose of shewing, that in ascending to a considerable distance from the surface of the earth, as the height increases in *arithmetical* proportion, the density of the air decreases *geometrically*. Thus, at an elevation of 3½ miles, the air is only half as dense as at the earth's surface: at twice that height, or 7 miles, the diminution of density is fourfold: at 10½ miles, the density is diminished in the proportion of 8 to 1: at 14 miles, 16 to 1, &c.

In Mr. Gowring's first lecture, he had exhibited the experiment of breaking one of the small bottles, called *breaking squares*, by the *pressure* of the atmosphere, and he now produced the same effect, in two different ways: first, by placing a similar bottle, furnished with a valve, opening inwards, under the receiver, and exhausting the air, when the air within the bottle being prevented from escaping, burst the bottle by its *spring or elasticity*; and secondly, by *compressing* into a strong receiver a large quantity of air, by means of a forcing-pump, when the small bottle, placed under the receiver, was soon shivered to pieces by the great increase of pressure.

Mr. Gowring then observed, that as *condensation* produces heat, *evaporation* produces cold; and he endeavoured to exemplify the latter remark, by placing a vessel, containing water, under the receiver of the air-pump, and exhausting the air. A small vessel of sulphuric acid was connected with the apparatus, for the purpose of absorbing the moisture from the air which escaped from the water in considerable quantities as the exhaustion proceeded; and if the experiment had been performed under favourable circumstances, *ice* would have been formed on the surface, in consequence of the abstraction of the caloric of fluidity from the water, during the process of evaporation. This experiment, which had perfectly succeeded a short time before, in a private room, was unsuccessful upon the present occasion, owing to the great warmth of the air in the theatre.

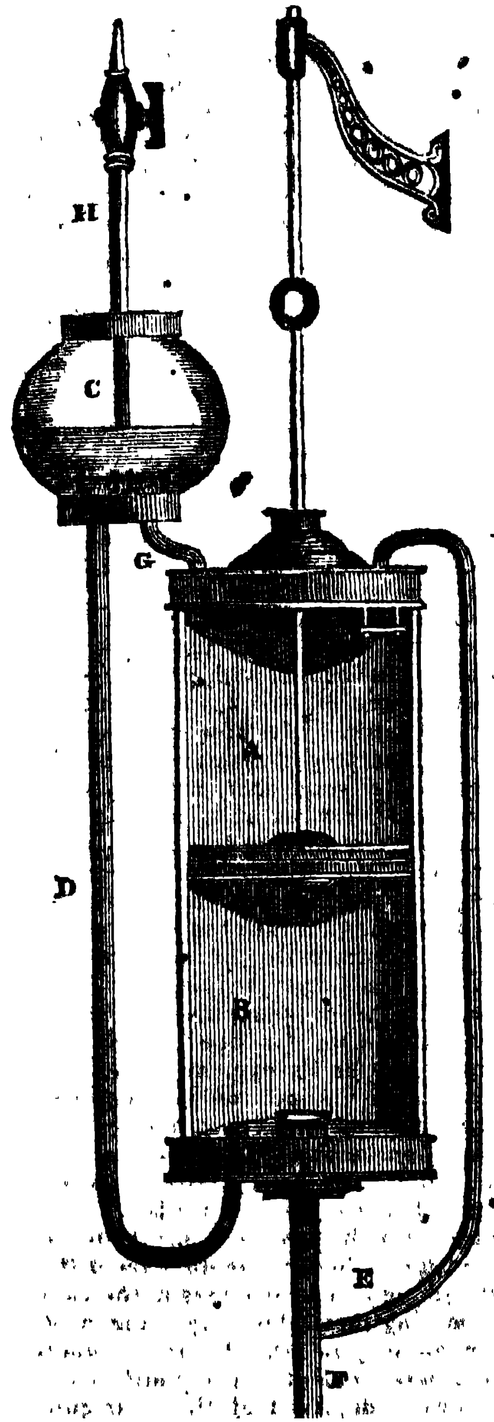
To prove that *condensation* produces heat, Mr. Gowring placed a small portion of German tinder, or *amadon*, in a brass cylinder, to which an air-tight piston was exactly fitted; and having suddenly condensed the air in the cylinder, by driving down the piston, the tinder was instantly ignited by the heat generated by condensation, and a match was lighted by it without difficulty. Mr. Gowring also shewed that water may be boiled at a much lower temperature than 212°, when the pressure of the air is diminished or removed, by repeating the experiment of boiling some water in a flask, &c., as exhibited by Mr. Ogg, in his lecture on heat (Vide Vol. II. p. 8). Mr. Gowring observed, that water will boil at about 94° under the receiver of an air-pump. He also repeated the final experiment of the previous lecture, by introducing, successively, three atmospheres of mercury into a long bent tube, for the purpose of shewing that the *elasticity* of the air is, under all circumstances, equal to its *pressure*. Upon the former occasion, the extremity of the shorter leg of the tube was secured by a brass cap, which was hardly sufficient to preserve it perfectly air-tight, against the great pressure of three atmospheres; but the end of the tube had since been hermetically sealed, and the experiment was, therefore, performed with more accuracy as to the result.

Mr. Gowring then proceeded to exemplify the compressibility of the air, by a variety of striking and ingenious experiments. A bladder, fully distended with air, was placed under a strong receiver, into which more air was forced, when the bladder shrunk to a very small size; but was again fully inflated, as soon as the additional air, which pressed upon it, was allowed to escape. A large quantity of air was forced into another bladder, and the operation was continued till the assistant was in a perspiration; the bladder was, however, strong enough to resist the great internal pressure, but the moment the Lecturer made a minute aperture in it with a pin, it burst into fragments with a tremendous report. Mr. Gowring also accurately weighed a vessel containing air, and, after forcing an additional quantity of air into it, again attached it to the balance, when it immediately preponderated; and it required the addition of 8 or 9 grains, in the opposite scale, to restore the equipoise.

The *compressibility* of the air was further illustrated, by forcing a considerable quantity of it into a vessel containing coloured water, and furnished with a narrow tube, reaching nearly to the bottom. The vessel was then placed in the large basin which is used for hydrostatic experiments, and the stop-cock being opened, the compressed air drove the water up the tube, forming a beautiful fountain, several feet in height. Several jets, of various forms, were then successively attached to the vessel, and the water was thrown horizontally, diagonally, &c. with considerable force. Some of the Members, in the front seats, thought it advisable to retreat from the "philosophical christening," which they received during the experiment, and much merriment was exhibited amongst those who escaped it.

The *air-gun* was next exhibited, and its construction described. This instrument, as we have stated on a former occasion, owes its effect to the condensation of the air which is driven into the stock, and which, upon being liberated, drives out the balls, with which it is loaded, with great velocity, by the force of its expansion into its former bulk. Mr. Gowring observed, that he had no pretensions to the character of a good shot, but his assistant would try his skill, for the purpose of exemplifying the effect of the air-gun. Mr. Bluett, the apparatus-keeper, then loaded the piece, and stepping forward into the area, in front of the lecture table, he discharged it twice, at a target suspended against the wall, and proved himself a dexterous marksman, for one of his shots struck the bull's eye, and the other was within an inch of it. The Lecturer remembered that, many years ago, when he was at Tiverton, some of the neighbours were alarmed by occasional noises in the walls of their houses, which they were unable to account for; when it was discovered that two young gentlemen were in the habit of amusing themselves, by firing shots from an *air-gun* into the rooms where these persons slept. The youths were, of course, deprived of their air-gun; an instrument, the use of which, Mr. Gowring believed, was prohibited by the law.

The Lecturer then described the operation of the *forcing-pump*, by a reference to the diagram which we gave in our second volume, p. 294; and he also exhibited another diagram, which we have correctly copied in the following engraving, representing a forcing-pump, on an improved construction.



In the *common forcing pump*, a continuous stream of water is kept up by the expansion of the air previously compressed in the air-vessel; but it is only by the *downward* stroke of the piston that the water is driven from the pump-barrel into this vessel. In the improved forcing pump, exhibited in the above diagram, this object is accomplished both by the *upward* and *downward* motion of the piston. When the piston is raised in the cylinder, or pump barrel, the water from the pipe, *f*, communicating with the well, passes through a valve opening into the cylinder, and fills the barrel below the piston, as at B. Upon depressing the piston, the former valve is closed, and the water is driven through another valve into the pipe *d*, which conveys it into the air-vessel C. During the descent of the piston, by an ingenious arrangement of suitable valves, opening inwards or outwards according to circumstances, the water from the pipe, *f*, is driven through the tube, *e*, into the upper part of the pump-barrel, A, and upon again elevating the piston, the water above it passes through *g*, into the air-vessel C. Thus a continuous and powerful stream is driven through the jet, *h*; and it is upon this principle that the best fire-engines are now constructed.

Mr. Gowring exhibited a beautiful model of a *forcing pump* of this kind, and exemplified its operation by directing a strong jet of water into the large basin before him, and also by attaching to the pipe, *h*, several of the jets used in a former experiment. He then proceeded to explain the principle of the *diving-bell* (Vide vol. II. page 296), and observed, that the air it contains undergoes considerable compression, which has occasioned some inconvenience to persons who have descended to great depths, by producing a painful oppression on the tympanum of the ear. To avoid this inconvenience, some individuals have put cotton in their ears, and have found it driven forcibly in by the pressure of the condensed air in the diving-bell.

After some further experiments, Mr. Gowring entered upon a brief illustration of the cause of *wind*, which may be defined as *air in motion*. The general cause of wind is the rarefaction of portions of the air by heat, in consequence of which the lighter portions ascend, leaving a partial vacuum, while the cold air rushes in to supply their place. To this cause may be attributed the general tendency of the winds from the poles towards the equator, the occurrence of the *trade-winds*, &c. [Our readers will find this interesting subject very ably illustrated by Dr. BIRKBECK, in his lecture on the winds, inserted in our First Volume, page 194.]

The usual time being elapsed, Mr. Gowring concluded, in nearly the following words:—

We have now been engaged for three evenings, in considering the nature and mechanical properties of *Air*: a fluid into which we were plunged the moment we were born, and in which we move, and have our being.

I trust it will not be considered that we have dedicated too much time (although the subject is not entirely novel to you) to the consideration of a body, which by its constant variations in temperature and weight, continually agitates our frame, and to which we may attribute many of our sensations both irksome and pleasant.

It sustains the clouds and contributes to the formation of all kinds of meteors. By its buoyancy and constant motion, it removes all noxious vapours. Plants grow in and are nourished by it. Without air there would be neither sound nor voice, nor language. Plants could not transmit their odours to us, or even vegetate; animals would perish, and the whole world languish and decay.

Mr. Gowring finally remarked, that he had not at first contemplated the delivery of more than three Lectures; but as the subject was not quite concluded, he should, in compliance with the wish of the Committee, extend the course to one or two more Lectures; and on Wednesday Evening next, after finishing his remarks on Pneumatics, he should take up the subject of Hydrostatics, strictly so called, and should illustrate some of the principles of that science.

MR. COOPER'S
FOURTEENTH LECTURE ON CHEMISTRY.

METHODS OF ASCERTAINING THE QUANTITY OF CARBONIC ACID CONTAINED IN CARBONATES OF LIME, SOILS, &c.—SULPHATES OF LIME — SELENITE — PLASTER OF PARIS—SULPHURETS OF LIME—COMBINATIONS OF LIME WITH PHOSPHORUS—PHOSPHURET AND PHOSPHATE OF LIME — PHOSPHURETTED HYDROGEN — BARYTES—CARBONATE, SULPHATE, MURIATE, AND NITRATE OF BARYTES—BARIUM, THE METALLIC BASE OF BARYTES — ITS COMPOUNDS, &c.

FRIDAY, JANUARY 6TH.

MR. COOPER commenced, by reminding his hearers that, in his last lecture, he had terminated the consideration of the combinations of *carbonic acid* with *lime*; but it should be observed, in addition to what has been already stated, that it is an object of considerable importance, to be able to estimate the quantity of *carbonic acid* which exists in combination with *lime*; for as soils owe their fertility to the quantity of *carbonate of lime* they contain, it is essentially necessary to have the means of ascertaining this fact with correctness. The mode of doing this may be inferred from the effect produced by forming a solution of *carbonate of lime* in *acid*. *Marble*, in most instances, consists of *lime, carbonic acid, silica*, and *alumina*; but other substances also enter into the composition of *lime-stones*, some of which are called *magnesian lime-stones*, from their containing a quantity of *magnesia*. In all cases, however, the quantity of *pure carbonate of lime*, in any impure carbonate, may be ascertained by the quantity of *carbonic acid* evolved during its decomposition.

Mr. Cooper here exemplified, in a very clear and satisfactory manner, the mode of arriving at the precise quantity of *carbonic acid* contained in any *carbonate of lime*. To one of the scales of an accurate balance was suspended a flask, containing a quantity of *dilute muriatic acid*, which was exactly counterbalanced by weights on the opposite sides, so that the scales were in perfect equipoise. The Lecturer then took a piece of *calcareous spar*, of which he carefully weighed 100 grains with the same balance; after which he transferred the fragments of *calcareous spar* into the vessel containing the *muriatic acid*, which immediately exerted a powerful chemical action in the *carbonate*, and *carbonic acid* was given off in great abundance. This action was allowed to continue for a considerable time, and, at a subsequent period of the lecture, Mr. Cooper stated the result of the experiment; by which it appeared, that the loss of weight occasioned by the escape of *carbonic acid*, amounted to 39 grains. It was therefore evident that the *carbonate* employed (*calcareous spar*) contained 39 per cent. of *carbonic acid*. Now, as the scale of chemical equivalents points out the exact proportions in which *lime* and *carbonic acid* combine to form *pure carbonate of lime*, it is easy to ascertain, either by the rule of proportion, or by moving the slider of the scale till carbonic acid stands opposite to 39, the quantity of *pure carbonate* contained in the *calcareous spar*, which will be found to amount to about 39 grains; the remaining 11 grains consisting of other substances. By the same simple process, a known quantity of any soil may be examined, and the quantity of *carbonate of lime* it contains may be correctly estimated, by the weight of the *carbonic acid* given off during its decomposition.

Another mode of arriving at the same result is, by measuring the *bulk* of the *carbonic acid* obtained from any *carbonate of lime*. This operation was performed by introducing some fragments of *calcareous spar* into a graduated glass vessel, standing over quicksilver in the mercurial trough. Some *muriatic acid* was then passed up, when an immediate chemical action ensued between the *muriatic acid* and the *carbonate*, which proceeded till the *carbonic acid*, generated during the process, displaced nearly the whole of the mercury in the vessel. Now, if we operate by this method on a known quantity of *carbonate of lime*, and the jar is graduated so as to specify the number of cubic inches of *carbonic acid* generated during the experiment, the quantity of *pure carbonate* is readily ascertained; for, as the weight of 100 cubic inches of *carbonic acid* (46.59), is to the weight of the *pure carbonate*, of which it forms a part, so is the weight of the *carbonic acid* graduated to the quantity of *pure carbonate* contained in the substance operated upon. The effects of *carbonate of lime* on soils have been ably discussed by Sir Humphry Davy, in his work on that subject; but his method of arriving at the desired result is troublesome, and his apparatus expensive; in fact, nothing more is necessary than the modes of experimenting, which have just been exhibited.

Lime also enters into combination with *sulphuric acid*. There is a class of substances very abundant in nature, called *sulphates of lime*, exhibiting considerable variety in the external forms of their crystals. One of them is called *selenite*, which is met with in the blue clay of London, and in many other places, and is used for making *plaster of Paris*. This substance is *selenite*, deprived of its water, by submitting it to a red heat. Mr. Cooper here produced a large transparent crystal of *selenite*, or *sparry gypsum*, which he submitted to the heat of the furnace, observing that it would lose its transparency, when its water of crystallization was driven off, and become opaque, like all other crystals under the same circumstances. In subjecting this substance to heat, which renders it *anhydrous*, as it is termed by chemists, it is necessary to keep up the heat for a considerable time, and also to take care that no greater than a dull red heat is applied to it; for, if too high a temperature be employed, the *plaster of Paris*, which results, is not so good, and does not *set* so well. The Lecturer was not prepared to explain the exact cause of this effect, but it appeared to him that too great a heat occasioned some change in the state of aggregation of the particles of the substance.

When the *sulphate of lime* was subsequently taken out of the furnace, it was perfectly opaque; and, upon being pulverised, it formed *plaster of Paris*. The reason of its *setting* is, its re-uniting with the *water* it has parted with, during its exposure to the heat of the furnace. If we now supply this *anhydrous gypsum* with *water*, it becomes a *hydrate*; the *water* entering into combination with the *gypsum*, and heat being given out, in consequence of the *solidification* of the portion of *water* which combines with it. Under some circumstances, it is found necessary to employ *plaster of Paris*, which does not *set* so soon. When this is the case, as in the casting of large figures, the object is attained, either by exposing the *plaster of Paris* to the air, for some time before it is used, or by mixing a small quantity of *urine* with it; by which means, the speed with which it sets is diminished.

With respect to the combinations of *lime* with *sulphur* and *sulphuric acid*, it should be observed that, by exposing the *sulphates of lime* to a red heat, they become decomposed and converted into *sulphurets*; the *sulphuric acid* being deprived of its *oxygen*, while the *sulphur* combines with the *lime*, and forms a *sulphuret of lime*. There is no occasion, however, to employ artificial means for procuring *sulphuret of lime*

If a quantity of *lime* and *sulphur*, in a state of solution, are boiled together over a spirit-lamp, we obtain a substance called *hydroguretted sulphuret of lime*, which is formed by the union of *sulphur*, *lime*, and *hydrogen*, and is very useful as a chemical test. This compound has been called Hannibal's wine-test, from the circumstance of its detecting the minutest quantity of *lead* that wine may contain in solution; owing to the accidental introduction of a few shot into the vessel, or from any other cause. Mr. Cooper exemplified the utility of this substance as a chemical test, by its instantly precipitating the *lead* from a very small quantity of a solution of that metal.

Sulphuric acid has so great an affinity for *lime* that it is difficult to separate them, and the decomposition of *sulphate of lime* must, therefore, be effected in a circuitous way. It must first be converted into a *sulphuret*, by pulverising it, and heating it in contact with *charcoal*. By this means the *oxygen* and *carbon* pass off in the form of *carbonic acid*, leaving the *sulphur* and *lime*, which are then easily separated by *muriatic acid*, which combining with the *lime*, sets *sulphuretted hydrogen* at liberty, which is then treated with any of the *alkaline carbonates*.

Although *lime* possesses so powerful an affinity for *sulphuric acid*, yet when we attempt to precipitate *lime* from any solution containing it, by means of *sulphuric acid*, the object is accomplished with some difficulty, which arises from the great solubility of the *sulphate of lime*. Mr. Cooper here poured some *sulphuric acid* into a vessel containing water holding *lime* in solution, which it might naturally be expected would have become turbid by the precipitation of the *lime*, but the fluid remained as clear as before. That the *sulphuric acid* had, however, combined with the *lime* there could be no doubt; for we should find, upon boiling the contents of the vessel to dryness, that *sulphate of lime* would result; the constituents of which it is difficult to separate when they have once united.

Lime combines with *phosphorus*, and forms *phosphuret of lime*. The usual mode by which this combination is effected upon a small scale, is to place some *phosphorus* (in a dry state) in the extremity of a tube, the remainder of which is filled with small fragments of *lime*. The tube is then laid across a furnace till the *lime* becomes red hot. Heat is then applied to the extremity of the tube containing the *phosphorus*, which is cautiously sublimed, and combining with the *lime*, forms the substance called *phosphuret of lime*. Mr. Cooper exemplified this process, which occupied some time; but, upon examining the tube, towards the close of the lecture, a number of white and chocolate-coloured fragments were found, the latter of which was the *phosphuret* alluded to. This substance possesses the property of becoming decomposed, when thrown into water, and also of decomposing the water in which it is immersed; a portion of the *phosphorus* uniting with the *hydrogen* of the water, and forming *phosphuretted hydrogen*, which inflames on coming in contact with the atmosphere[*]; while another portion combines with *oxygen*, and forms *phosphoric acid*. Mr. Cooper performed this curious experiment, by throwing some of the dark-coloured fragments into a vessel of water, when their decomposition immediately commenced, and portions of the *phosphuretted hydrogen* successively ascended to the surface of the water, where they instantly burst into a flame, and burnt with considerable brilliancy.

Phosphate of lime is a combination of *lime* and *posphoric acid*, and is a substance of considerable importance, as being the basis of *bone*. In the process of preparing *ammonia*, it will be recollected, that the bone which was employed retained its form, though it was completely black, owing to the combination of *phosphoric acid*, *lime* and *charcoal*, in which state it forms *ivory black*. We have only to heat this substance till the *charcoal* is burnt out, when the *phosphate of lime* is obtained, which, in common language, is called *bona*, or *bone-ash*. This substance is used in the manufacture of *china*, and being mixed in proper proportions with *clay* and *silex*, communicates the beautiful transparency which is so desirable.

Phosphate of lime, though infusible by the most intense heat of the furnace, may be readily fused when in combination with other substances. It is of great importance to refiners of gold and silver; for *bona* is employed in the manufacture of their *cupels* or *tests*, to which purpose it is peculiarly applicable for two reasons;—first, on account of its *infusibility*, and secondly, because it is so *porous*, that it absorbs all the *oxides* of the baser metals, and leaves the gold or silver in a state of perfect purity.

Phosphate of lime is also used by chemists as the source from which they derive *phosphoric acid*, *phosphorus*, and all its various compounds. *Sulphuric acid*, for example, having a stronger affinity for *lime* than *phosphoric acid* has, will unite with the former, and set the latter at liberty.

The next of the *alkaline earths* to which our attention will be directed, is *barytes*. This earth, like *lime*, is never found in nature in a pure state, being always in combination with the same substances which combine with *lime*. *Sulphate of barytes*, or *heavy spar*, as it has been called, is sometimes found in distinct crystals, and sometimes in a massy state, in which no precise crystalline forms are distinguishable. *Carbonate* and *sulphate of barytes* are employed to produce all the other *salts of barytes*. If we operate on *carbonate of barytes* with *nitric* or *muriatic acid*, the results are *nitrate* and *muriate of barytes*. *Sulphate of barytes*, which is a compound of *sulphur* and *barytes*, is the most insoluble of all chemical compounds, and cannot be decomposed without the agency of fire. The combinations of *sulphur* with *lime*, adverted to in a former part of the lecture, are analogous with the compounds formed by the union of *sulphur* with all the other alkaline earths, whether *barytes*, *strontites*, or *magnesia*.

Muriatic acid, added to *barytes*, forms the salt called *muriate of barytes*, which is obtained in a crystalline form, if the solution is evaporated to cooling; but in producing the *muriate* by the direct solution of the *carbonate* in *muriatic acid*, there is some danger of a quantity of *iron* being mixed with it. In order to free it from this metal, a small quantity of the earth of *barytes*, in a pure or caustic state, must be added, which precipitates the iron, and leaves the pure *muriate* of *barytes*. *Nitrate of barytes* is procured in the same manner, by operating on the *carbonate* with *nitric acid*. This salt, like the preceding, is capable of crystallizing by evaporation, and from the crystals of *nitrate of barytes* the pure *barytic earth* is procured, by subjecting the crystals to a red heat.

Barytes is of considerable importance in chemical research, as a test for the detection of the most minute quantity of *sulphuric acid*. Mr. Cooper illustrated this remark, by adding to a vessel of distilled water a single drop of *sulphuric acid*. A small quantity of the water was then poured into a solution of *barytes*, and though the quantity of *sulphuric acid* was so minute as to be scarcely appreciable, its presence was immediately detected, by the formation of an insoluble precipitate in the *barytic* solution.

There are many other preparations of *barytes*, which it is unnecessary to particularize, as it enters into exactly the same combinations as *lime*. *Barytes*, like the other alkaline earths, must be considered as a *metallic oxide*, the basis of which is the metal called *barium*. There is also another compound of *oxygen* and *barium*, called the *peroxyde of barium*, which is formed by passing *oxygen gas* over *barytes*, at a red heat. *Barium* also enters into combination with *chlorine*, *muriatic acid*, *sulphuric acid*, *phosphorus*, *sulphur*, &c. forming compounds similar to those mentioned in speaking of *lime*.

Mr. Cooper concluded by stating, that his next lecture would be devoted to the consideration of the remaining alkaline earth, *strontia* and *magnesia*.

Dr. **Birkbeck** then announced, that the arrangements for opening the **Apparatus Room**, and the **Laboratory** for the inspection of the Members, being now completed, the Apparatus Room would be open, for that purpose, every Tuesday, from 12 till 2, and from 6 till 10 o'clock; and every Thursday, from 10 till 2. The Laboratory would also be open every Thursday, from 6 till 10 in the evening.

Dr. **Birkbeck** availed himself of the same opportunity to remind the Members of the liberal and benevolent proposition of the Rev. Mr. **Fellowes**, which was communicated to the last Quarterly General Meeting (vide page 126), to give Two Prizes of £10 each, to be competed for by the Members of the Institution. Though the preliminaries were not yet quite arranged, it was probable that these prizes might be awarded at the next Quarterly Meeting, and, therefore, those Members who wished to obtain them, should lose no time in making the necessary exertions. They would recollect, that one of these prizes was for the best Model of any new or improved machine, and the other, for the best Essay on one of the mechanical powers.

LECTURES FOR NEXT WEEK.

Wednesday, January 18, Mr. Gowring's Fifth Lecture on Pneumatics, &c.

Friday, January 20, Mr. Cooper's Sixteenth Lecture on Chemistry.

SHIP LIBRARIES.

The managers of the Port of Hull Society have issued a circular, soliciting donations of books, towards the formation of libraries on board merchant-ships. Of the utility of this plan, under proper regulations, there can be no question. In the course of long voyages, sailors are often placed in circumstances favourable to instruction; and we hope the benevolent individuals, who have set the measure on foot, will find a disposition on the part of the public, and particularly of those connected with shipping, to second their praise-worthy endeavours.

OBSERVATIONS ON PHRENOLOGY.

To the Editor of the Mechanics' Register.

Mr. Editor,—Observing you have lately given your readers a brief outline of Phrenology, the following observations, on the discovery of this science by Dr. Gall, will serve to throw greater light on the subject, if you think them worth a place in your Register:—

Dr. Gall, a physician of Vienna, and born at Tiefendrun, in Swabia, in 1757, being from an early age given to observation, was struck with the fact, that each of his brothers and sisters, companions in play, and school-fellows, was distinguished from other individuals by some peculiarity of talent or disposition. Some of his school-fellows were characterized by the beauty of their penmanship; some by their success in arithmetic, and others by their talent for acquiring a knowledge of natural history, or languages. Their dispositions were equally different; and this diversity appeared also to determine the direction of their partialities and aversions. Not a few of them manifested a capacity for employments which they had never been taught; some cut figures in wood, or delineated them on paper; some devoted their leisure to painting, or the culture of a garden; whilst their comrades abandoned themselves to noisy games, or traversed the woods to gather flowers, seek for birds' nests, or catch the butterflies. In this manner each individual presented a character peculiar to himself, and Dr. Gall never observed that the individual who, in one year, had displayed a selfish or knavish disposition, became in the next a good and faithful friend.

But the scholars with whom Dr. Gall had the greatest difficulty in competing, were those who learnt by heart with great facility; and, some years afterwards, having changed his place of residence, he still met individuals, endowed with an equally great talent of learning to repeat. He then observed, that the persons so gifted had prominent eyes; and recollected that his school-fellows, who had been his rivals, in gaining from him the places he had obtained by the merit of his original compositions, by their great facility of repetition, had been distinguished by the same peculiarity. When he entered the university, he directed his attention, from the first, to the students whose eyes were of this description, and found that they all excelled in getting rapidly by heart, and in giving correct recitations, although many of them were by no means distinguished in point of general talent. This observation was recognized also by the other students in the classes; and, although the connexion between the talent and the external sign, was not at this time established upon such complete evidence, as is requisite for a philosophical conclusion, Dr. Gall could not believe, that the coincidence of the two circumstances was entirely accidental. From this period, therefore, he suspected that they stood in an important relation to each other. After much reflection, he conceived, that if memory for words was indicated by an external sign, the same might be the case with the other intellectual powers; and therefore, all individuals, distinguished by any remarkable faculty, became the object of his attention. By degrees, he conceived he had discovered external characteristics, which indicated a decided disposition for painting, music, and the mechanical arts. He became acquainted also with some individuals remarkable for the determination of their character, and he observed a particular part of their heads to be largely developed. This fact first suggested to him the idea of looking to the head for the signs of the moral sentiments. But, in making these observations, he never conceived for a moment, that *the skull* was the cause of the different talents, as has been erroneously represented; for, from the first, he referred the influence, whatever it was, to the *brain.*

In following out, by observations, the principle which accident had thus suggested, he, for some time, encountered difficulties of the greatest magnitude. Hitherto, he had been alto gether ignorant of the opinion of Physiologists, touching the brain, and of Metaphysicians, respecting the mental faculties—*he had simply observed nature.* When, however, he began to enlarge his knowledge of books, he found the most extraordinary conflict of opinions every where prevailing; and this, for the moment, made him hesitate about the correctness of his own observations. He found that the moral sentiments had, by an almost general consent, been placed in the thoracic and abdominal viscera; and that, while Pythagoras, Plato, and other physiologists, placed the sentient soul, or intellectual faculties, in the brain, Aristotle placed it in the heart—Van Helmont in the stomach—Des Cartes in the pineal gland, and Drelincourt and others in the cerebellum.

He observed also, that a great number of philosophers and physiologists asserted, that all men are born with equal mental faculties; and that the differences observable among them are owing, either to education, or to the accidental circumstances in which they are placed. If all difference were accidental, he inferred that there could be no natural signs of predominating faculties; and, consequently, that the project of learning by observation, to distinguish the functions of the different portions of the brain, must be hopeless. This difficulty he combated, by the reflection, that his brothers, sisters, and school-fellows, had all received very nearly the same education, but that he had still observed each of them unfolding a different character, over which circumstances appeared to exert only a limited controul. He observed also that, not unfrequently those, whose education had been conducted with the greatest care, and on whom the labours of teachers had been most freely lavished, remained far behind their companions in attainments. "Often," says Dr. Gall, "we were accused of want of will, or deficiency in zeal; but many of us could not, even with the most ardent desire, followed out by the most obstinate efforts, attain, in some pursuits, even to mediocrity; while, in some other points, some of us surpassed our school-fellows without an effort; and almost, it might be said, without perceiving it ourselves. But, in point of fact, our masters did not appear to attach much faith to the system which taught the equality of mental faculties; for they thought themselves entitled to exact more from one scholar, and less from another. They spoke frequently of natural gifts, or of the gifts of God; and consoled their pupils, in the words of the Gospel, by assuring them that each would be required to render an account, only in proportion to the gifts he had received."

Being convinced by these facts, that there is a natural and constitutional diversity of talents and dispositions, he encountered in books still another obstacle to his success in determining the external signs of the mental powers.—He found that, instead of faculties for languages, drawing, distinguishing places, music, and mechanical arts, corresponding to the different talents which he had observed in his school-fellows, the metaphysicians spoke only of general powers, such as perception, conception, memory, imagination, and judgment; and when he endeavoured to discover external signs in the head corresponding to these general faculties, or to determine the correctness of the physiological doctrines taught by the authors already mentioned, regarding the seat of the mind, he found perplexities without end, and difficulties insurmountable.

Dr. Gall, therefore, abandoning every theory and preconceived opinion, gave himself up entirely to the observation of nature. Being a friend to Dr. Nord, Physician to a Lunatic Asylum in Vienna, he had opportunities, of which he availed himself, of making observations on the insane. He visited prisons and resorted to schools; he was introduced to the courts of princes, to colleges, and the seat of justice; and wherever he heard of an individual distinguished in any particular way, either by remarkable endowment or deficiency, he observed and studied the development of the head. In this manner, by an almost imperceptible induction, he conceived himself warranted in believing, *that particular mental powers are indicated by particular configurations of the head.*

Hitherto he had only resorted to physiognomical indications, as a means of discovering the functions of the brain. On reflection, however, he was convinced, that physiology is imperfect when separated from anatomy. Having observed a woman of 54 years of age, who had been afflicted with hydrocephalus from her youth, and who, with a body a little shrunk, possessed a mind as active and intelligent as that of other individuals of her class, Dr. Gall declared his conviction, that the structure of the brain must be different from what was generally conceived,—a remark which Fulpius also had made, on observing a hydrocephalic patient who manifested the mental faculties. He, therefore, felt the necessity of making anatomical researches into the structure of the brain.

In every instance, when an individual, whose head he had observed while alive, happened to die, he used every means to be permitted to examine the brain, and frequently did so; and found, as a general fact, that, on removal of the skull, the brain covered by the *dura mater*, presented a form corresponding to that which the skull had exhibited during life.

The successive steps by which Dr. Gall proceeded in his discoveries, are particularly worthy of observation. He did not, as many have imagined, first dissect the brain, and pretend, by that means, to discover the seats of the mental powers; neither did he, as others have conceived, first map out the skull into various compartments, and assign a faculty to each, according as his imagination led him to conceive the place appropriate to the power. On the contrary, he first observed a concomitance betwixt particular talents and dispositions, and particular forms of the head: he next ascertained, by removal of the skull, that the figure and size of the brain are indicated by these external forms; and it was only after these facts were determined, that the brain was minutely dissected, and light thrown upon its structure.

Having proceeded thus far, Dr. Gall, for the first time, delivered lectures on his systems at Vienna, in the year 1796, and, in 1800, Dr. Spurzheim began the study of Phrenology under him, having, in that year, assisted, for the first time, at one of his lectures. In 1800, Dr. S. was associated with him in his labours; and since that period, has not only added many valuable discoveries to those of Dr. Gall, in the anatomy and physiology of the brain, but formed the truths brought to light by their joint observations, *into a beautiful and interesting system of Mental Philosophy.*

P.

CAPTAIN SYMMES' THEORY OF THE EARTH.

To the Editor of the Mechanics' Register.

SIR.——Looking over a packet of New York Papers, a few days back, I saw the following account of Captain Symmes' New Theory of the Earth, and I should like to see the opinion of some of your Correspondents on the subject. But can we wonder more at the Earth being open at the poles and hollow within, than at the curious figure of the planet, Saturn?

I am, Sir,
Your Constant Reader,
W. W.

On the evenings of Monday and Wednesday, the 24th and 26th ult., Mr. Reynolds delivered lectures to the citizens of this place, on Captain Symmes' New Theory of the World. All who heard him were much gratified; many were convinced of the plausibility, and some of the truth of the theory.

Captain Symmes supposes the South Polar opening to be 6,000 miles in diameter, the verge commencing on one point, at latitude 46, and on the other, at lat. 34. Mr. R., in his lectures, confined his observations, principally, to the North Polar opening, which is supposed to be 4,150 miles in diameter, the verge commencing on the continent of Europe, at lat. 68, and on the Pacific Ocean, at lat. 55. The Captain had been able thus minutely to locate the verge, from facts acquired by a diligent research and thorough investigation of the narratives of different navigators. He finds it indicated by the dark colour of the sea, in its corresponding latitudes, by its being the coldest part of the earth, and by tracing around it a similarity in the productions of nature, the variation and dip of the magnetic needle, &c.

The shape of the earth at the verge, independently of its high latitudes, he argues, is the cause of intense cold, for the same reasons, that elevated situations, in any part of the world, are the coldest; and the temperature of the atmosphere, in all parts of the earth, equidistant from the verge, will be the same; hence, we find the climate in England correponds to the climate in the state of New York, both being about the same distance from the verge; whereas, if the earth was a spheroid, as is generally supposed, the heat would be in proportion to the distance from the equator, which, it is well known, is not the case. Many other phenomena of nature, hitherto considered inexplicable, are satisfactorily and rationally accounted for, by supposing the earth to be open at the poles, and hollow within. For instance, the Aurora Borealis, the variation and dip of the needle, and others which we will presently mention. Navigators in high latitudes have frequently found log-lines, and celestial observations, to indicate a curvature of the earth, which they thought it impossible they could have passed over, and at other times, they sailed an astonishing distance before they gained the natural curvature. If we suppose they were sailing, in the first instance, on the verge, and in the second, around it, the solution will be easy; in the same regions, objects have been seen one hundred and thirty miles, and more; and the sun has appeared to Burrentz, and other navigators, many days before his astronomical time. These phenomena have been accounted for on the principles of refraction; but the new theory affords an explanation far more satisfactory.

Many curious facts, such as the migration of animals, fish, birds, to and from the arctic regions, are brought to bear strongly in favour of the new theory, and a forcible confirmation of it is drawn from a telescope-view of some of the planets.

Captain Parry relates that, when in the Northern regions, on the 21st of December, the twilight was so great, that he could see to read the smallest print by it with ease. The sun was then farthest from him; the moon's declination was fifteen degrees; consequently, below the horizon; and it was, likewise, so cloudy, that very few stars could be seen. He mentions particularly, that, when reading, *he turned his face to the south* The advocates for the new theory believe that the light must have come through the polar opening. Captain Symmes believes that navigators and travellers have been nearly, or quite beyond the verge. In the year 1770, Mr. Hearne, an officer of the Hudson's Bay Company, was sent to prosecute discoveries in the North-West. He passed through a cold, barren country, where he found game extremely scarce, and suffered many hardships. From the mouth of Copper-mine river, he turned his course in the directions which, according to the new theory, must have led him into the interior of the world, and, after travelling a considerable distance in that direction, he found a more hospitable clime; a country where game of all descriptions was abundant; where the soil was rich and loamy, and covered with timber of th largest size.

In the course of the lectures, it was plainly demonstrated, that the new world does not suffer for want of light and heat, but is highly favoured with both.

We have given but few of the facts and arguments that are adduced in favour of the new theory; they will, however, be sufficient to shew that it has more plausibility than is generally supposed, and that it has not emanated from a disordered imagination, but that the author is worthy of encouragement.

Captain Symmes,' we believe, is yet detained at Hillsborough, Ohio, by indisposition, but will join Mr. Reynolds, as soon as his health will permit. He has made an engagement with the Russian Government, to accompany a polar expedition they have projected, and has been requested to hold himself in readiness to set out some time this winter.

New York Advertiser, Nov. 10th.
By them, from, Wheeling (Ohio) Gazette.

FORM OF THE ULTIMATE PARTICLES OF WATER.

To the Editor of the Mechanics' Register.

SIR,—Is it not probable that the ultimate particles of water, instead of being spheres, are OCTAEDRONS? I have been led to this supposition from the following considerations:—

1st. It has been hinted (Vol. II. page 426), that if they were spheres, they would be capable of greater compression than has been found out by Canton, Perkins and others.

2dly. It has been thought that the particles of water possess great freedom of motion among each other; but this appears to be not the fact. We know that substances of any kind reduced very small assume a fluid appearance, somewhat resembling that of water. Mr. Boyle, after finely powdering and sifting some dry plaster of Paris, put it into a vessel over a fire, when it soon began to boil, exhibiting all the motion and appearances of boiling water. Although but a powder, the parts of which we know are very different from one another, and just as accident has formed them; yet they heaved waves like water upon agitation. Also a heavy body will sink to the bottom, and a light one rise to the top. There is no reason, then, to suppose that the particles of water are *spheres*, when we see their fluidity very well imitated by a composition, the parts of which are of various forms and sizes: also whoever has observed water when boiling, has seen that a portion of it, which lies next to the bottom, owing to its being exposed to a greater degree of heat, the particles of it become rarefied, and in consequence ascend, carrying with them all those particles which are immediately above them to a height at which their gravity overcomes the force which first set them in motion; they then fall over towards the centre; this motion continues until the water is all equally heated, and then the whole mass of it rises.

3dly. It is well known that water, when freezing, expands considerably; and it is generally admitted by philosophers, that this is done by a new arrangement of its particles; but this could not be the case, were its particles *spheres*, the space between which, no new arrangement could enlarge; and, unless the particles were elastic, which they are proved not to be, no expansion could possibly take place.

4thly. Were the particles of water spherical, the lateral pressure would be considerably greater than it is at present.

Having thus far objected to the idea of the particles of water being *spherical*, I proceed to state why I think it probable that they are *octaedrons*.

1. That were they of this form, they would be incapable of compression, as they would all fit into each other, and form a compact body.

2. That supposing them to be octaedrons, it will account for the expansion of water when freezing; as octaedrons are capable of being made to occupy a larger space by a different arrangement, which I have before shown that spheres will not.

W. YOD. T.

ARBOR DIANÆ; OR, THE PHILOSOPHICAL TREE.

Take one ounce of silver, and dissolve it in 2 or 3 ounces of spirits of nitre; put this solution into a mattrass or Florence-flask, into which you have put 18 or 20 ounces of quicksilver. Let the phial or flask be filled up to the neck, and place it in some convenient place, where no one can meddle with it, for forty days, in which time you will see a tree spread forth its branches, with little balls at the end thereof.

USE OF WHISKERS IN FELINE AND OTHER ANIMALS.

It may not perhaps be generally known, that, as far as they have been traced, the whiskers which adorn the upper lip in tigers, panthers, leopards, cats, seals, &c., are very copiously supplied with nerves ; and altogether in a manner which precludes the possibility of our considering them as merely ornamental appendages. Mr. Broughton on this subject observes:—

"To ascertain this fact, I put it to the test of experiment in the following man-

"I placed walls of books upon the floor, so as to resemble the streets of a town opening into each other; and having closed the eyes of a kitten completely, I set it down to find its way through the lanes of books. It continued to move on wherever a free communication presented itself, holding its head cautiously down close to the floor, and very adroitly avoiding contact with the sides of the walls, the corners of which it also turned without approaching closer than just sufficient to touch the tips of the whiskers slightly, when it always drew back instantaneously. At length it found its way out freely. I then cut off the whole of the whiskers close to the face, and again set it down, to observe whether this would produce any alteration in its manner. The kitten now showed evident signs of having lost the only remaining means of guiding itself. It struck its head repeatedly against the sides of the walls, ran against all the corners, and tumbled over steps placed in its way, instead of avoiding all these as before the removal of the whiskers.

"Not the slightest sensation of pain appeared to attend the cutting off the bristles; I should therefore suppose that their substance is insensible, and that it carries on the impressions it receives by vibration, their sensation being propagated through the nerves inserted in the bulbs of the bristles.

"In the mouse, I found also a similar developement of nerves, proportionably large in relation to its whiskers.

"From these facts, I imagine that certain animals are supplied with whiskers for the purpose of enabling them to steer clear of opposing substances in the dark. The mamilia having lips and considerable facial developement, are probably furnished with these bristles or fine tubes of a compact substance, which, while they readily yield to pressure, convey the impression and excite the simple sensation of contact; just as the antennæ of the sapia, the lobster, the snail, insects, &c., are to all appearance constructed for the purpose of the sense of touch.

"Animals which seize their prey by night, and such as explore dark passages, are furnished with whiskers. The bat is supposed to avoid walls and houses by the exquisite sensibility of its wings; it seems however probable, that it is indebted for its safety, in this respect, to its whiskers or feelers, as they may be termed."

CASTOR-OIL.

The castor-oil plant *(palma christi)* is indigenous to Southern Africa, and is found in abundance in most parts of this colony. It may be useful to some persons, in remote situations, to know, that the safe and valuable medicine which this plant produces, is readily obtained by the following simple process:—The ripe seeds are cleared from the husks, well stamped in a mortar, and then boiled in water till the oil rises to the surface. This is carefully skimmed off; but as some water will be still mixed with the oil, it is necessary to boil it over again in an iron pot, until the water be thoroughly expelled by evaporation. This method of obtaining castor-oil is practised, with perfect success, by the Moravian missionaries at Gnadenthal; who also use indiscriminately the seeds of the different varieties of the plant found in that vicinity, without perceiving any difference in the quality of the oil.—*South-African Advertiser.*

QUERIES.

No. 35.

Sir,—I shall feel obliged by your Correspondent, Left Hand, (see p. 112) informing me, whether the wood to be stained requires any preparation, previous to laying on the sub acetate, and also, the best method of polishing it when done? I allude to the staining of picture frames and mouldings.

Your constant Reader,

W. D.

No. 36.

Sir,—Being short-sighted, to a certain extent, I have latterly accustomed myself to wear glasses; which, though they be relevant to the sight, while in use, yet appear to have deteriorated it, when laid aside. A communication (through the medium of your excellent Register,) of the cause of the above evil, and of its antidote, will much oblige, Sir, your humble servant, and former Correspondent, I. N. H.

No. 37.

Why does pork-lard present, on cooling, such a waved appearance; whilst other fats, such as beef and mutton, (under the same circumstances) remain smoooth?

Reading. H. D.

No. 38.

Sir,—I shall feel obliged by the following Question being inserted in your valuable Register:—

Which is the best way of preserving the end of an oak post, to be put in the ground—whether by *pitching* or *scorching* it; as the latter is frequently done, and, by many, considered the best. I shall, therefore, esteem it a favour if any of your intelligent readers can inform me, why it contributes to preservation, and why it is preferable to pitch?

I remain, Sir,
Your constant reader, and
Member of the L. M. Institution,
W. H. H.

No. 39.

Mr. Editor,—I should be obliged, if any of your Correspondents would explain to me, why a person, after ascending with a balloon in the air, descends only as far as the wind carries him, from the spot where he first set out; when it is said that the motion of the earth, in the latitude of London, is about 300 miles per hour; and it is well known that the current of the wind is not always in the same direction as the motion of the earth? This question will, perhaps, appear frivolous to many, but an explanation will much oblige

An Inquirer.

ANSWERS TO QUERIES.

Query No. 34, Page 192.

PREPARATION OF PHOSPHORUS.

Sir,—I have great pleasure in transmitting the following, for the information of your correspondent J. W—s.

Calcine a quantity of bones in a crucible, letting them burn until they cease to smoke, or give out any smell, then reduce them to a fine powder; dilute one hundred parts of this in a porcelain basin, with four times its weight of water, and then, by degrees, pour in forty parts of sulphuric acid (stirring the mixture with a glass rod every turn); the mixture will then become hot, emitting a quantity of air bubbles; it is to remain in this state for one day, being stirred occasionally with a glass rod, that the sulphuric acid may act more freely on the powder.

The whole should then be filtered through a cloth, and the liquid which runs through should be caught in a basin, while the white powder in the cloth (after clean water has been several times passed through it into the basin) may be thrown away.

Into the liquor in the basin continue to pour nitrate of lead, until the white precipitate ceases to fall, and then filter the whole; the white powder that remains in the filter is to be well washed and dried, when one sixth of its weight of charcoal powder is to be mixed with it. The mixture is to be put into an earthenware retort, which is to be put into a furnace with the mouths plunged into a vessel of water. The retort is then to be heated to whiteness, when a quantity of bubbles will issue from it, some of them taking fire on coming to the air: at length the phosphorus begins to drop out (much in the form of melted wax) and congeals under the water. It is then generally moulded into sticks by the following process: Put the phosphorus into glass tubes, and immerse them in warm water, when it will become soft, taking the form of the tubes, which may then be left in water till it grows cold, and the phosphorus may be taken out of the tubes. This, however, as well as all other processes of this kind, must be done under water, to prevent the combustion of the phosphorus.

Philos Tecnoon.

TO CORRESPONDENTS.

We have only room to acknowledge the favours of our Correspondents in general terms; and to request that they will, in future, direct their communications to the Editor, at Messrs. Gifford & Co.'s, No. 52, Paternoster Row.

THE LONDON
MECHANICS' REGISTER.

"These are thy blessings, Industry! rough power,
"Whom labour still attends, and sweat and pain;
"Yet the kind source of every gentle art,
"And all the soft civility of life."

THOMSON.

No. 70.] SATURDAY, JANUARY 21, 1826. [Price 3d.

MR. AUST'S CIRCULAR BARREL-PUMP.

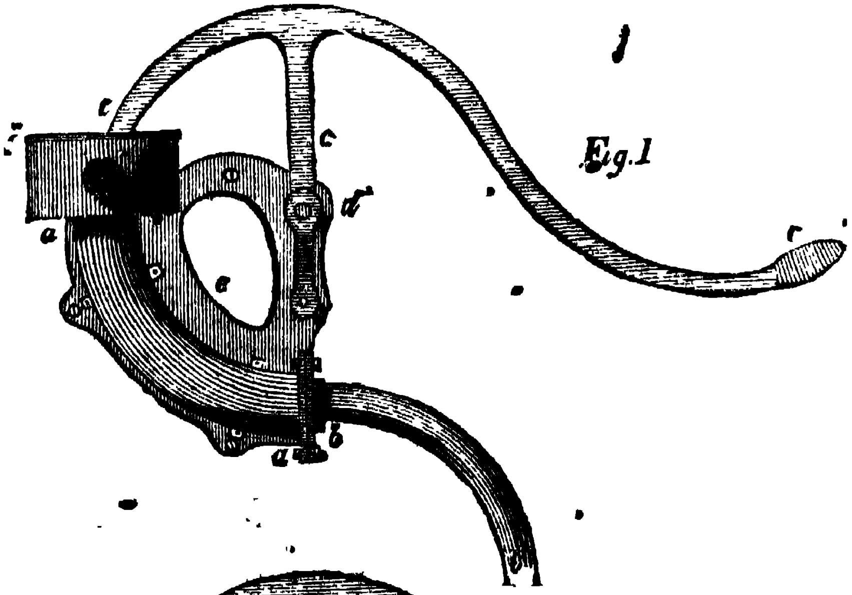


Fig. 1

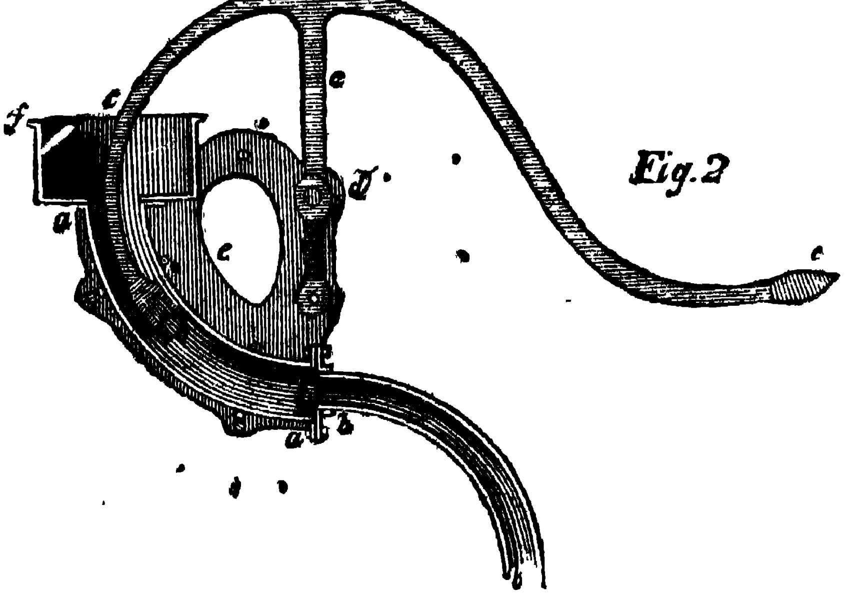


Fig. 2

MR. AUST'S CIRCULAR BARREL PUMP.

Having given, in our second Volume (page 294), an engraving of the common sucking and forcing-pumps, and, in our last Number, a view of an improved forcing-pump, for the purpose of illustrating the lectures on Pneumatics, delivered by Mr. Partington, and those now delivering on the same subject by Mr. Gowring, to the Members of the London Mechanics' Institution, we this week present our readers with a view and section of a very ingenious pump, invented by Mr. Aust, of Hoxton, in which the barrel, or cylinder, instead of being straight, as in ordinary pumps, is bent so as to form a quarter of a circle.

The advantages which this contrivance possesses over pumps of the usual construction, are stated by the inventor to depend on the curvilinear form of the barrel, which allows, and indeed obliges, the rod, the handle, and the lever, on which it works, to be all in one piece: hence results, not only a much greater simplicity in the workmanship, and consequent cheapness, but a greater steadiness and precision of action, whereby more water is discharged, and the leathering of the valve will last a much longer time, without wanting repair. The cost of a pump of this construction, two and a half inches in the bore, will not exceed 3*l.*; and the weight of the barrel, which is of brass, is not more than three pounds.

Several gentlemen, after using Mr. Aust's circular barrel pump for years, have confirmed the inventor's description of its advantages, and have stated that it works easier, and with much greater power, than the common pump; producing a better vacuum, and discharging more water, in proportion to its size.

Figure 1 is a view of the pump, a section of which is seen in Figure 2.

a a, is the barrel, forming a curve of a quarter of a circle; fixed at its upper end to the head *f*, and at its lower to the pipe *b*.

b b, the pipe that conducts the water into the barrel; it is made curvilinear, in order that as little obstacle as possible may be opposed to the ascending water.

c c c, the piston, the handle, and the lever, on which it works, all in one piece; the piston part is curved, to correspond with the curvature of the barrel.

d, the pivot on which the lever of the handle works.

e, a flat plate, to which the whole apparatus is fastened, and which may itself be screwed to a block of wood fixed against the wall.

LONDON MECHANICS' INSTITUTION.

MR. GOWRING'S FOURTH LECTURE ON PNEUMATICS, &c.

IMPROVED AIR-GUN—OBSERVATIONS ON AIR AS A MEDIUM OF SOUND—STRUCTURE OF THE HUMAN EAR—NATURE OF SOUND—COMPARATIVE VELOCITIES OF LIGHT AND SOUND—ECHO, OR REFLECTED SOUND—INVISIBLE GIRL—HYGROMETER—HYDROSTATICS—SPECIFIC GRAVITY OF BODIES—THEIR COMPARATIVE WEIGHTS IN AIR AND IN WATER—CARTESIAN DEVILS, &c.

WEDNESDAY, JANUARY 11TH.

Mr. Gowring having, in his last lecture, among other illustrations of the *compressibility* of the atmosphere, introduced the *air-gun*, commenced the present evening's discourse by exhibiting another *air-gun*, constructed upon an improved principle, and so contrived, that the air could be condensed into it without the necessity of separating the barrel from the stock. The compressed air was contained in the space between two concentric cylinders, and it could be charged with much less trouble than the common air-gun. It is upon this principle, that air-guns are made in the form of a common walking-stick.

Mr. Gowring then proceeded to that branch of the science of Pneumatics, which treats of air as the *medium of sound*, and which is known by the name of Acoustics. As he did not intend to enter very deeply into the subject, it was not his wish to apply that term to his remarks on the nature of *sound*, which he should only speak of as it was connected with *air*, without which there could be no sound. *Sound* owes its existence to the compressibility and elasticity of the air, by which it is enabled to receive the impulses communicated by bodies in motion, and to transmit to the ear the vibrations it has received.

The Lecturer here exhibited a diagram, representing the internal structure of the *human ear*, on a scale of about four times the natural size. The ear consists of various arches, so constructed as to convey the sounds through the auditory passage to the *tympanum*, or *drum*, which membrane is affected by all the vibrations communicated to it. Behind the *tympanum*, and connected with it, is a bone called the *malleus*, or *hammer*, which communicates with another bone, called the *incus*, or *anvil*. With this bone is connected another, bearing an exact resemblance to a *stirrup*, and thence called the *stapes*. This *stirrup* acts on a fluid contained in a spiral bone, resembling a *shell*, and therefore called the *cochlea*, whence the vibrations received from the *tympanum*, are conveyed to the brain. These are the mechanical means, so far as we are enabled to judge of them, by which sound is communicated to the brain.

Sound is more powerful, in proportion as the air is more dense; and the vibratory motion, communicated by a sounding body, acts in concentric surfaces of spheres, which may be compared to the successive coats of an onion; and these vibrations diminish in intensity, as their distance from the sounding body increases. It is, however, a singular fact, that the *velocity of sound*, or its propagation in time, is always the same; for a weak sound moves with exactly the same velocity as a strong one: Mr. Gowring illustrated the diminution of *intensity* in the vibrations communicated to the air, by exhibiting a cone, and supposing a sound to be generated at its point, or apex, which represents a single particle of air; in which case it may be imagined that, as the sound proceeds towards the base of the cone, its intensity becomes weakened, because the same quantity of force is distributed over a larger surface.

Light proceeds with the amazing velocity of 12 millions of miles in a minute, while *sound* travels at the rate of about 13 miles in the same time. From the almost inconceivable rapidity of light, compared with that of sound, the motion of the former may, for practical purposes, be considered instantaneous; and it was by observations on the intervals, between the flash and the report of guns fired at night, and at a considerable distance, and by other circumstances, that philosophers were enabled to ascertain that sound moves at the rate of 1142 feet in a second. By a knowledge of this fact, we may calculate the distance of a vessel in distress, or of a thunder-storm; for, as the pulse of a healthy person beats about 75 times in a minute, sound will pass through 915 feet during every pulsation. If, therefore, we can count 6 pulsations between the flash and the report of a cannon, or between the lightning, and the thunder which follows it, we may conclude, that the vessel or the thunder-cloud is about a mile distant.

That air is a *medium of sound*, was proved by an experiment which we have before described (*vide* Vol. I. p. 183); viz., by placing a bell under a receiver, and exhausting the air from it, when its sound was entirely lost, though the clapper still continued to strike it.

Echo is caused by sounds meeting with obstructions, which throw them off at angles, exactly equal to the angles at which they strike the obstructing surface; so that the *angle of reflection* is always equal to the *angle of incidence*. Mr. Gowring illustrated this remark by a diagram, which had been exhibited for the explanation of an analogous fact in the science of Optics (*vide* Vol. I. p. 198), and he further exemplified the manner in which sound is reflected, by the motion of two billiard balls on a large square frame, which he observed would also elucidate the principles of the game of billiards. A groove was fixed near one side of the frame, and, at some distance from it, a heavy mass of polished iron was placed at right angles to the groove. The Lecturer then drove one of the balls along the groove, which, striking perpendicularly against the iron, rebounded in the same line, and returned into the groove. A second ball was then placed on a line at right angles with the groove, and the iron being adjusted to an angle of 45°, the first ball was again driven against it; and, as it now struck the iron at an angle of 45°, and flew off at the same angle, it struck the second ball, which was at right angles to the direction of the first, or at 90°. Mr. Gowring repeated the experiment at two or three different angles, and thus afforded a very clear, as well as amusing proof, that the angles of incidence and reflection are equal to each other.

The Lecturer here directed the attention of the Members to two pieces of blue paper, which had been placed against the walls of the Theatre, on opposite sides of the gallery, and observed, that if any of them were disposed to try the experiment, after the lecture was over, they would find, that a whisper at one of these points would be distinctly heard at the opposite point, though not at any intermediate part, for it was only at a certain distance that sound could be distinctly reflected.

As sound moves at the rate of 1142 feet in a second, and as not more than 9 syllables can be pronounced upon an average in the same space of time, it follows, that in order that an echo may be distinct, the distance of the surface from which it is reflected, should be rather more than 63 feet. There are several curious echoes in different parts of London; for instance, on one part of London Bridge, two persons placed in the arched recesses which face each other, can hold a conversation in a low voice, with facility; and in Finsbury Square, the sound is distinctly repeated three times. There are also echoes in which one person hears both the direct and the reflected sound, while another only hears the former.

As a further illustration of the nature of reflected sound, Mr. Gowring next adverted to the *invisible girl;* a contrivance which, he observed, it was unnecessary for him to describe, as a very correct description of it had been given in the "MECHANICS' REGISTER," a publication which, he had no doubt, the Members were all in the habit of perusing (vide page 191 of the present volume). He had, however, an apparatus of a similar description, which he now exhibited, and which, in its external appearance, resembled a pedestal or stand for a lamp. Within this was concealed a tube, with an orifice in its side, in which was placed a piece of tin at an angle of 45°, which, upon the principles before stated, reflected the sound in a direction perpendicular to that of the tube. Opposite to a corresponding opening in the pedestal, the Lecturer held a globular glass vessel, with a large trumpet-shaped mouth, and observed, that by this arrangement, any sound conveyed through the tube (which might easily be made to communicate with an adjoining room), would appear to the hearers as though it proceeded from the glass vessel.

Mr. Gowring then adverted to the *hygrometer*, as an instrument connected with the air, the name of which is derived from two Greek words, signifying *a measurer of moisture.* The *hygrometer*, however, is not a *measurer*, but only an *indicator* of moisture in the atmosphere. There are many substances which contract when wetted; a common clothes-line, for instance, if stretched tightly when dry, will either be broken, or will draw the posts out of the perpendicular when it becomes wet; and if, on the contrary, it is tightened in a wet state, it will hang loose when it becomes dry. The Lecturer here described the construction of the *hygrometer* which is usually attached to barometers, and of several other instruments acting upon the same principle. One of these *hygrometers* was presented to the Institution, by Mr. Clark, and in its appearance resembled a common thermometer; but the bulb containing the mercury consisted of a *rat's bladder*, which was so extremely sensible to moisture, that by merely breathing on it, the mercury instantly sank to a considerable depth in the tube. None of these instruments, however, furnish an exact mode of ascertaining the quantity of moisture in the atmosphere.

That air is a supporter of combustion and a supporter of life, has, no doubt, been fully illustrated, during the lectures delivered to the Members, on chemistry. But as it is usual to exhibit an experiment on this subject, in speaking of pneumatics, the Lecturer placed three tapers under a receiver, at different heights, which were successively extinguished as the *oxygen* of the air was consumed.

Having thus completed all he had intended to state on the subject of Pneumatics, Mr. Gowring proceeded to the science of HYDROSTATICS; a term derived from two Greek words, signifying water and weight. From this derivation, it would appear to apply only to water and weights of bodies; but, in a more enlarged sense, it has for its objects the weight, pressure and motion of fluids in general. It was his intention, however, this evening, to confine his attention to water, as a *standard of weight*, or comparison by which the *specific gravities* of bodies are ascertained.

Mr. Gowring first explained the meaning of *specific gravity*, by means of a hydrostatic balance, which he observed had been used by M. Garnerin, the celebrated aeronaut. With this balance he weighed balls of *ivory*, *tin*, *brass* and *lead;* the whole of which were of equal weight, though they differed materially in bulk; but as the smallest ball was just as heavy as the largest, it must evidently contain the same quantity of matter, though packed, as it were, into a less space. It was also evident, from the experiment, that the ball of *lead* was denser, bulk for bulk, than the *brass* ball; the *brass* than the *tin*, and the *tin* than the *ivory*. This variation in the density of different substances of the some bulk, is called the *specific gravity*, which is estimated by the proportion which their weight bears to that of an equal bulk of water.

Mr. Gowring then observed, that the mode of ascertaining the specific gravities of bodies, by weighing them in water, was discovered by the celebrated Archimedes, whose experiments established the important principle in Hydrostatics, "*that every body immersed in a fluid, loses a weight equal to the weight of its own bulk of the fluid in which it is plunged.* The Lecturer related the well known anecdote of the application of the king of Syracuse to the Philosopher, to discover whether his goldsmith had adulterated the metal which had been given to him to make a crown of gold. As the crown was very valuable, the King wished this fact to be ascertained without its sustaining any damage; and Archimedes observing, while he was bathing, that his body displaced a certain portion of the water, suddenly conceived the idea of applying this fact to the solution of the problem in question, and was so elated at the discovery, that he sprang from the bath, and ran through the streets, naked as he was, exclaiming "I have found it! I have found it!"

The experiment of Archimedes, by which the above principle was established, was now performed by Mr. Gowring, who produced two metal cylinders, one of which so exactly fitted into the other that it was with difficulty introduced and withdrawn. The cylinders were then weighed together, and correctly counterpoised, by weights placed in the opposite scale of the hydrostatic balance, which, notwithstanding the weight of the beam, turned with 1-8th of a grain. The inner cylinder, which was closed at both ends, was then withdrawn, and being suspended below the other, was immersed in a vessel of water, when its loss of weight, by immersion, caused the opposite scale immediately to preponderate. The upper cylinder was then cautiously filled with water, which exactly restored the equilibrium; and, as it had been previously shewn, that the capacity of this cylinder was precisely equal to the cylinder which was immersed, it was demonstrably proved that the latter had lost a weight, exactly equal to the weight of its own bulk of water.

Mr. Gowring next exhibited the application of this principle to the *assaying of metals*, which clearly elucidated the manner in which Archimedes detected the adulteration of the crown of the king of Syracuse, by weighing it, first in *air*, and then in *water*. The Lecturer produced *a bad sovereign*, which weighed only $73\frac{3}{4}$ grains, instead of about 124, the weight of a good one. He then weighed the bad sovereign in water, and found that it had lost 7 grs. of its weight. He then divided $73\frac{3}{4}$ (its weight in air) by 7 (its loss of weight in water), which gave 10 and a fraction as its *specific gravity*, or the proportion in which its weight exceeded that of an equal bulk of water. A *good sovereign*, weighing in air 123 grains, was then subjected to the same operation, and also lost 7 grains by immersion. But $123 \div 7$, gave 17 4-7th as the specific gravity of the good sovereign; and, as it is known that the specific gravity of *standard gold* is nearly 17 6-10ths, it is evident that, by this experiment, accurately performed, the proportion in which it is alloyed with other metals may be correctly ascertained; and it was in this way that Archimides not only discovered that the golden crown was alloyed, but the exact quantity of the inferior metal that had been mixed with it.

The Lecturer also performed some other experiments, by weighing, in a similar manner, some foreign silver coins, for the purpose of shewing that it is easy to discover, in this way, their exact value, in comparison with the English silver currency.

Mr. Gowring then adverted to a simple mode of determining the specific gravity of *mercury*, and shewed that 28 inches of *water* contained in one tube, nearly counterbalanced two inches of *mercury*, a tube of the same diameter; proving that the specific gravity of *mercury* is, to that of *water*, as 14 to 1 nearly. The same fact was exemplified by a long glass tube, bent like a syphon, and open at both ends; containing a quantity of mercury in the lower part or bend of the tube; the mercury standing at an equal height in both legs of the syphon. *Water* was then poured into the longer leg to the height of 14 inches, when the *mercury* rose one inch in the shorter leg; and the addition of every 14 inches of water, elevated the mercury an additional inch, till 6 counterbalanced 84 inches.

The Lecturer's final experiment was an exhibition of a cylindrical glass vessel, nearly filled with water, and containing three little figures of men, which enclosed a portion of air sufficient to render them specifically lighter than the water, and consequently, to keep them at its surface. Upon depressing with the hand the air-tight cover of the vessel, the air above the surface of the water, and also that contained in the little figures, was compressed into a smaller compass, and the figures, by admitting a portion of water into them, becoming specifically heavier than the water in which they were immersed, sank to the bottom of the vessel. By varying the pressure of the hand on the cover of the vessel, the figures can be made to rise or fall, or remain stationary, in any part of the fluid, at the pleasure of the operator. The little figures employed in this experiment have been called the "*Cartesian Devils*," because it was first suggested by Des Cartes, and the figures were originally formed like *devils*; not, however, as they are represented by Milton, who is the only author who has "given the Devil his due," and has neither painted him *black*, nor appended a *tail* to his person.

Mr. Gowring observed, in conclusion, that he should resume the subject of *specific gravity* in his next lecture, when he should also treat of the pressure of fluids in general.

MR. COOPER'S
FIFTEENTH LECTURE ON CHEMISTRY.

STRONTIA—CARBONATE AND SULPHATE OF STRONTIA—PREPARATION OF THE SALTS OF STRONTIA FROM ITS SULPHURET—TEST FOR DETECTING THE PRESENCE OF STRONTIA—ITS USE IN PRODUCING THE RED FIRE FOR THEATRICAL PURPOSES—MAGNESIA — ITS PREPARATION FROM MAGNESIAN LIMESTONE AND SEA-WATER—SULPHATE OF MAGNESIA, OR EPSOM SALT—MURIATE AND NITRATE OF MAGNESIA—COMBUSTION OF THE ALKALINE EARTHS, BY THE OXY-HYDROGEN BLOW-PIPE, &c.

FRIDAY, JANUARY 13TH.

Strontia, the alkaline earth of which we are about to speak, observed Mr. COOPER, was first discovered by Dr. Hope, of Edinburgh, about the year 1791, in a mineral brought from Strontian, in Argyllshire, Scotland, from which place its name is derived. This substance has hitherto been only discovered in two states of combination, viz., with *sulphuric* and *carbonic acid*. It is found in great abundance in several places, particularly in the neighbourhood of Clifton, where whole roads are formed of *strontia*, in combination with *sulphuric acid*. *Carbonate of strontia* is much more rare, and it is not from the *carbonate* that its *salts* are prepared for chemical purposes, but always from the *sulphate*, which is found in a variety of states, being sometimes *granulated*, and sometimes *crystalline*. In the latter state, it is readily known by the manner in which its crystals radiate from a centre, and it is from these crystals that its *salts* are obtained.

Mr. Cooper here exhibited a specimen of *crystallized sulphate of strontia*, and observed, that if a portion of it was subject to heat, in contact with carbonaceous matter, the *sulphate* would be converted into a *sulphuret*. There was not sufficient time in the last lecture to exhibit the effects of this operation on the sulphate of lime or barytes, but they might be inferred from the present experiment, which was exactly analogous. In performing this experiment, it is necessary, in order to insure the perfect decomposition of the *sulphate* (and the same remark applies to any other *earthy sulphate*), to use rather more charcoal than is sufficient to combine with the *oxygen* of the *sulphuric acid*. A quantity of charcoal powder is first put into the crucible to prevent the earthy matter from coming in contact with the sides of the vessel; for though the *sulphate* is not easily fused of itself, yet, if it is in contact with the earthy matter of which the vessel is composed, they are both liable to fusion. The *sulphate* must then be reduced to powder in a mortar, and mixed with a quantity of *saw-dust*, with as small a portion of water as may be necessary to form the mixture into a ball, which is then placed in the crucible, and completely covered with charcoal powder, to keep it from the sides of the vessel. The crucible is then put into the furnace, and subjected to a high heat, which decomposes the *sulphate of strontia*; the *oxygen* of the *sulphuric acid* combining with the *charcoal*, and forming *carbonic acid*, while the *sulphur* remains in combination with the *strontia*, and forms the *sulphuret*.

Mr. Cooper performed this operation exactly in the manner described, and at a subsequent period of the lecture, he withdrew the crucible from the furnace, when the complete decomposition of the *sulphate* was indicated by the fact, that no flame proceeded from the vessel. After suffering the crucible to cool, its contents were examined, when the whole of the saw-dust was found converted into charcoal, and the Lecturer proceeded to shew, that the *sulphuret of strontia,* which resulted from the operation, might be easily acted upon by any of the *acids.* Some *muriatic acid* was poured upon a portion of the *sulphuret,* when a considerable action immediately ensued, and a quantity of *sulphuretted hydrogen gas* was evolved, while the *strontia* entered into combination with the *muriatic acid,* and formed the *muriate of strontia,* though the same acid would have had no effect on the *sulphate* previous to its exposure to a red heat. Thus it appears, that the *sulphuret of strontia,* like the *sulphurets of lime* and *barytes,* can be easily decomposed by any acid, and that *nitric, muriatic,* or *sulphuric acid,* will displace the *sulphur* of the *sulphuret,* and, combining with the *strontia,* form, respectively, its *nitrate, muriate,* or *sulphate.*

Muriate of strontia may also be obtained, by subjecting *strontia* to the action of either *chlorine* or *muriatic acid gas.* Some *strontia* was here introduced into a retort, which was then exhausted, and the place of the atmospheric air was supplied by *muriatic acid gas* over the mercurial trough. An immediate chemical action took, when the two substances came in contact, and the vessel was filled with a white cloud. The action was accelerated by the application of a spirit-lamp, and the Lecturer stated, that when this experiment is performed with *strontia* which is newly prepared, and has had no opportunity of absorbing *water* or *carbonic acid,* the *strontia* frequently becomes red hot. The result of the operation was, a double decomposition of the substances employed; the *chlorine* of the *muriatic acid* combining with the *metallic base* of the earth, and forming *chloride of strontium,* while its *hydrogen* united with the *oxygen* of the *strontia,* and formed *water,* which was seen trickling down the interior of the retort. The same result *(chloride of strontium)* would have occurred by the action of *chlorine* and *strontium* upon each other; and this *chloride,* by absorbing moisture, becomes converted into *muriate of strontia.*

Strontia, like *barytes* and *lime,* is, in some degree, soluble in water, and the solution is found to possess a decidedly *alkaline* character. *Strontia* is also soluble in any of the mineral acids, except the *sulphuric* or *carbonic.* Mr. Cooper here formed solutions of *strontia* in water, in two separate glasses, into one of which he poured *nitric,* and into the other *muriatic acid.* In a short time, the solutions became perfectly transparent, and the Lecturer observed that, by evaporation, they would respectively form the *nitrate* and *muriate of strontia.*

These salts are only important as forming links in the chain of chemical compounds, and as being useful in enabling the chemist to detect the presence of other substances. Mr. Cooper then exemplified the mode of detecting the presence of *strontia,* by subjecting some *muriate of strontia* to the action of *alcohol* and setting fire to the solution, after raising it to a high temperature by applying a spirit lamp to the vessel. The flame was tinged with a vivid and beautiful red colour; and, as all solutions of the salts of *strontia* possess the property of communicating this colour to flame, its appearance furnishes a test for ascertaining the presence of *strontia* in very minute quantities.

The salt, called *nitrate of strontia,* is the substance employed in theatrical scenery, for producing the vivid crimson fire so frequently exhibited. Mr. Cooper here ignited a portion of the mixed substances used for this purpose, which produced an intense red flame, the effect of which, as exhibited in the theatres, was rendered more striking, by concealing the flame itself from the eyes of the audience, and exhibiting only the terrific glare of crimson light which emanated from it. It might, perhaps, be imagined that *nitrate of strontia* contained *oxygen* enough to produce the intense combustion just witnessed, but this is not the case, as it is also necessary to have recourse to other substances, which give out *oxygen* in the greatest quantity, and with the greatest facility. The composition, therefore, consists of *nitrate of strontia, oxymuriate of potash, sulphur* and *charcoal,* which are mixed in different proportions by different manufacturers; but it appears, that those mixtures which possess the greatest proportion of the *chlorate,* or *oxymuriate of potash,* produce the most intense light.

Having concluded his observations on the nature and properties of *strontia,* Mr. Cooper proceeded to the last of the alkaline earths, *magnesia.* This earth is found in great abundance in many parts of England, forming one of the constituents of *magnesian lime-stones*; and it is also found in *sea-water*, in which it forms the base of *muriate of magnesia*, one of the salts contained in that liquid. It is also discovered in the mineral waters in the vicinity of London, as at Streatham, &c.; and the mineral spring at Epsom owes its properties to the quantity of *magnesia* it contains. By evaporating the water of this spring, *sulphate of magnesia* is found, and to this circumstance may be attributed the origin of the name of *Epsom salts*, by which this substance is commonly known. Mineral springs are, however, very inadequate sources for producing *magnesia* for pharmaceutical or chemical purposes, and therefore it is necessary to have recourse either to *magnesian lime-stone* or *sea-water*, to obtain it in considerable quantities.

Mr. Cooper then exhibited a specimen of *magnesian lime-stone*, which he observed might be considered as a mixture of *carbonate of magnesia* and *carbonate of lime*. The mode of obtaining the *magnesia* from this stone, may be inferred from the fact, that *sulphate of magnesia* is very soluble, while *sulphate of lime* is a very insoluble salt. If then we operate upon this substance with moderately strong *sulphuric acid*, the *sulphates of magnesia and lime* will be formed by the union of the acid with the two earths; and the former may be obtained by filtration, while the latter remains, in a great degree, insoluble. Mr. Cooper exemplified this process by adding *sulphuric acid* to the *magnesian lime-stone*, the action being accompanied with the evolution of *carbonic acid* both from the *lime* and *magnesia*, and observed that this is one of the methods adopted for procuring *Epsom salts*, the manufacturers of which do not use the acid in a concentrated state, but employ it previous to its concentration; the *dilute sulphuric acid* being sufficiently strong for the purpose. In those neighbourhoods where *magnesian lime-stone* abounds, this mode is found very useful.

Another method of procuring *magnesia* is from *sea-water*, which contains a variety of substances, among which *common salt* exists in the greatest quantity; but it also contains a portion of *muriate of magnesia*. The ordinary mode of making *common salt* from *sea-water*, which is adopted on the coast of Essex, and other places, is by putting the *sea-water* into large reservoirs, called *salt-pans*, which occupy several acres of land, and are puddled with clay to make them water-tight. The water being evaporated by the heat of the sun, the salt which is formed on its surface is precipitated; more water is then poured in, and the operation repeated; after which, the salt is scraped up, and carried in baskets to the refining houses.

Now the *muriate of magnesia*, as it exists in *sea-water*, is a very deliquescent salt; being extremely greedy of moisture, and scarcely, if at all, capable of crystallization. It follows, therefore, that the *muriate of magnesia* may be readily separated from *common salt*, which possesses the property of being easily crystallized. It is well known that *common salt* frequently becomes damp in moist weather, which is owing to the *muriate of magnesia* that is mixed with it. *Basket-salt*, on the contrary, does not deliquesce, because it is previously freed from the *muriate of magnesia*. This operation is performed in the conical baskets in which this salt is brought to market, the *muriate of magnesia* being allowed to drain away, while the *muriate of soda* remains in the basket. Another source of deliquescence is, the presence of a portion of *muriate of lime*, which is the case with *rock-salt*.

All the *salts of magnesia* may be precipitated from their solutions by means of the *alkaline carbonates*; and it will, therefore, be found, that, upon adding an *alkaline carbonate* to *sea-water*, a precipitate will be formed, in consequence of its containing *magnesia*, and finally, by boiling, the whole of the *magnesia* may be obtained from it. Mr. Cooper here introduced an *alkaline carbonate* into a flask containing sea-water, which assumed a cloudy appearance, owing to the precipitation of *magnesia*. The operation was facilitated by boiling the mixture by a spirit-lamp, after which it was poured into a filter, in which the magnesia remained, while the soluble substances passed through.

Magnesian lime-stone is not fit for manuring soils, in consequence of the weak affinity of *magnesia* for *carbonic acid*. *Lime* possesses a strong affinity for this acid, and is, therefore, soon converted into a *carbonate*, while *magnesia* remains a long time in a *caustic* state, and in that state is injurious to vegetation. As soon, however, as it becomes perfectly saturated with *carbonic acid*, it is as well adapted for manure as *lime* is, for it has been found that when *magnesian lime-stone* has been employed for this purpose, though it has, for years, remained prejudicial to vegetation, it has afterwards been even more conducive to fertility than *lime*. It must not, therefore, be imagined, that the injurious effect of *magnesian lime-stone* upon soils, arises from any other cause than the greater length of time it requires to become saturated with *carbonic acid*.

The mode of separating *magnesia* from those substances in which it exists, in conjunction with *carbonic* or *sulphuric acid*, is a difficult problem in chemistry. They may first be converted into *sulphurets*, which are then soluble in acids, but it requires much experience before the separation of the *magnesia* can be satisfactorily accomplished. The *sulphates of lime* and *barytes* are difficult of solution, while the *sulphate of magnesia* is very soluble. The latter may, therefore, be separated from either of the former, by converting the substances in which they are combined into *sulphates*. Sometimes they are formed into *nitrates*; the *nitrates of lime*, *barytes*, and *strontia*, possessing different degrees of solubility, and all of them being less soluble than the *nitrate of magnesia*. Mr. Cooper was not, however, aware of any mode of effecting the perfect separation of *magnesia* from these substances.

Dr. Wollaston's method of detecting the presence of the most minute quantity of *magnesia* was, by converting the substance in which it existed into a *triple salt*, in combination with *phosphoric acid*. If we take a fluid supposed to contain *magnesia* (the mineral water of Streatham, for instance), we shall find, upon adding *carbonate of ammonia*, that no precipitation takes place; but, if we then add *phosphoric acid*, an immediate precipitate will be formed. This is occasioned by the formation of a triple salt, having a double base, and being a *phosphate of magnesia* and *ammonia*.

Mr. Cooper exemplified this effect, and proceeded to observe, that the mode in which this delicate test can be applied deserves particular notice, on account of the ingenuity of the invention. The Lecturer then spread a small quantity of the mineral-water, used in the last experiment, on a plate of glass, to which he added a few drops of *carbonate of ammonia*, which caused no precipitation. He then passed a glass rod across the plate, in different directions, and upon adding a little *phosphoric acid*, a precipitation instantly took place, and the lines traced by the rod became receptacles for the triple salt; for so extremely delicate was the test of the presence of *magnesia*, that wherever the rod had come in contact with the glass plate, the salt was distinctly visible.

Before terminating his remarks on the *alkaline earths*, Mr. Cooper exhibited the effects produced by their combustion, by means of the *oxy-hydrogen blow-pipe*. This powerful apparatus, having been supplied with *oxygen* and *hydrogen*, mixed in the proportions in which they combine to form water, the jet was ignited, and a small portion of *lime* was first exposed to the intense heat generated by the mixed gases. The gas-lights in the Theatre were lowered, to give due effect to the almost insupportable brilliancy of the light emitted by the combustion of the *lime*, a minute portion of which appeared in a state of fusion; proving that, though lime of itself may be infusible, it can be fused, when in contact with other earthy substances. The Lecturer expressed his opinion, that those writers who speak of having fused *lime*, must have operated upon it in an impure state, and contaminated with argillaceous or other substances.

Magnesia was next subjected to the flame of the mixed gases, and emitted a light almost as intense as that produced by the *lime*. The *magnesia* was more easily fused than the *lime*; and Mr. Cooper observed, that a mixture of the two earths may be reduced to a state of fusion, at a comparatively low temperature. The heat produced by the *oxy-hydrogen blow-pipe* is the greatest that can be generated by ordinary chemical agency, and in the present experiment, small portions of the *magnesia* became fused; especially those in contact with the pumice-stone support, in which the flame had made a hole reaching nearly through it.

Barytes was next operated upon; and the Lecturer stated that much had been written on the subject of this experiment by Dr. Clark, who argued that, by acting on *barytes* with the flame of the mixed gases, and using rather more than the usual proportion of *hydrogen*, he had succeeded in decomposing the earth, and converting it into a metal, which he called *plutonium*. This had been denied by others, and Mr. Cooper, who had himself seen some specimens of the metal, was of opinion, that the Doctor operated with materials which were contaminated with iron, or other impurities. He was confirmed in this opinion by the circumstance, that Dr. Clark could only produce his metal with one particular sort of *barytes*; and that, when he operated upon barytes prepared by the Lecturer, his experiment failed.

Strontia, under the same circumstances, is acted upon in a similar manner; and it should be remarked, that a mixture of all these earths may be fused with great facility.

The *oxy-hydrogen blow-pipe* at this moment exploded, but without producing any effect beyond the expulsion of the cork; and the Lecturer observed that he was not sorry this circumstance had occurred, as i afforded a convincing proof of the utility of the safety chamber, which effectually prevented the flame from being communicated to the gases contained in the bladder.

Mr. Cooper concluded, by stating that, as he had now finished his observations on the *alkaline earths*, he should, in his next lecture, direct his attention to some of those earths which were not possessed of *alkaline* properties, such as *alumina*, &c.

LECTURES FOR NEXT WEEK.

Wednesday, January 25th, Mr. Gowring's Lecture on Magnetism.

Friday, January 27th, Mr. Tatum's Lecture on Aerostation.

SPITALFIELDS MECHANICS' INSTITUTION.

THE Third Quarterly General Meeting of the Members of this Institution, was held on Thursday, the 23d ult., at Gibraltar Chapel, Bethnal Green Road, when the chair was taken by THOMAS GIBSON, Esq., the President, and the Report of the Committee, which was of a very favourable nature, was read by the Secretary, Mr. DOWNES.

It appeared by this Report, that the number of Members had increased during the Quarter, and now amounted to upwards of 300. A number of books had been presented to the Library, which consisted of 410 volumes, and the arrangements of the Committee had been completed for opening the Circulating Library on the 4th of the present month. The following donations in money had also been received:—

Messrs. Trumar, Hanbury, and Co.	£10
(Second annual donation.)	
C. F. Partington, Esq.	£5
Mr. Stange,	£5

In addition to which, Mr. Dunn, the Proprietor of the Royalty Theatre, had given a benefit, in aid of the funds of the Institution, the net proceeds of which, amounted to £21 16s. 6d. A number of valuable minerals had also been presented by Messrs. Hudson, Phillips, Graves, and other Members, and steps were taking to arrange these specimens for the inspection of the Members in general.

We were sorry to observe, from some passages in the Report, that the schools have not been so numerously attended as might have been expected; but we trust that the Members will not, in future, be backward in availing themselves of the important advantages offered to their acceptance in this valuable department of the Institution.

The cordial thanks of the Meeting were voted to Mr. DOWNES, the Secretary, for his kind offer to instruct the Members gratuitously in the mathematics, the use of the globes, stenography, &c.; for the excellent lecture which he delivered in October last, in consequence of the indisposition of Mr. Wilson; and for his liberal offer to deliver, gratuitously, a course of lectures, to continue not less than three months.

Thanks were also unanimously voted to the Committee, and to the Chairman, for his valuable services on all occasions; after which, the Meeting was adjourned.

MR. HOLDITCH'S LIFE-BEACON.

BY an inadvertent omission on the part of our artist, the second and third figures, explanatory of the construction of Mr. Holditch's Life-Beacon, were not included in the frontispiece to our last Number. We therefore hasten to supply this omission, by introducing them this week, and we refer our readers to page 195 for the description.

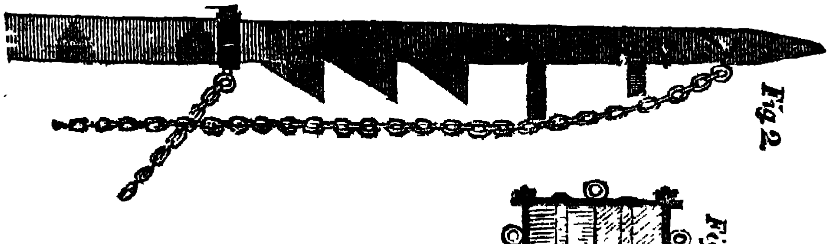


Fig 2.

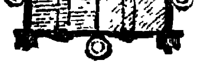


Fig. 3.

ABERDEEN MECHANICS' INSTITUTION.

(From the Scotsman.)

A Correspondent has sent us the Second Report of this Institution, from which we are happy to find that it appears to be in a flourishing condition. The receipts for the year ending October 1825, were about 205*l.* and the disbursements 222*l.* There were 362 Members, paying 10 shillings each, by two instalments, but about one-third of these did not pay up their second instalment. The sum received in donations was 4[illegible]*l.* Professor Paul gave 38 lectures on Mechanics; the Rev. Dr. Forbes the same number on Chemistry; and short courses, on Optics and Mathematics, were given by the Treasurer and Secretary—*all gratis*. The Committee consists chiefly of tradesmen, builders, smiths, plumbers, &c. The Members hold private meetings in the lecture-room, to converse on the subject of the lectures; and they have the use of a library of scientific books.

As warm friends to institutions of this kind, we regret to see them connect themselves with doctrines, which enlightened men must reprobate. In giving lectures gratis, on Chemistry, Dr. Forbes has been a benefactor to the Institution; but in his closing Address, which the Committee have been imprudent enough to print, he has uttered sentiments which go far, in our judgment, to cancel the merit of his services. He tells the mechanics, that Belles Lettres, Political Economy, General Politics, and even History, are dangerous studies; that none but restless agitators would make them dabblers in poetry and criticism—that "a little knowledge is a dangerous thing;" and that they should meddle with nothing but physical science and the Bible! Observe, he does not mean that nothing but physical science should be *taught in the Institution*, an opinion in which we would nearly concur, but he holds that if a mechanic reads Hume or Robertson, Locke or Smith, Pope or Milton, his mind will be perverted!

We pass over the harshness of the doctrine; but let us see how far it is rational and just, and whither it will lead us You say, Dr. Forbes, that a little knowledge, a smattering of history, poetry, belles-lettres, or any thing else, "edifieth not;" but "puffeth up," and is a dangerous thing. But pray tell us what is a smattering? Our principle is, that knowledge, in every degree and proportion, is salutary; that what is nourishing aliment in pounds, does not become poison in ounces or pennyweights. The child, in his primer, has but a smattering of knowledge, compared with the boy who has been whipped through Barry's Collection: the latter has but a smattering, compared with the youth who translates Virgil, and has mastered Euclid —he again leaves the college, and enters into active life with a mere smattering, where his acquisitions are weighed against those of his teacher. Nay, the learning of this teacher too, Dr. Forbes himself, for instance, if put in the balance with that of a Parr or a Porson, would be found, we suspect, to be but a smattering, which edifieth not, but puffeth up, and is, of course, dangerous! The tenth century was a period of "little knowledge," compared with the fifteenth: the fifteenth falls as far below the nineteenth; and the improvements of the next two centuries will, beyond a doubt, shew, that La Place and Cuvier, Leslie and Malthus, Mackintosh and Brougham, had but a "little knowledge." Where shall we draw the line, between that amount of knowledge which is wholesome, and that which is noxious—between what is safe, and what is dangerous? Is the boy corrupted by his first lessons, and only improved by his last? The truth is, as a man may know without having a professor's gown on his back, *all knowledge exists only in degree;* and the acquisitions of one age reduce those of the preceding to the rank of a smattering. Dr. Forbes is right: "a little knowledge" *is* a dangerous thing; but none at all is infinitely worse. The best informed may be misled, but the utterly ignorant are much better fitted to become the dupes of designing men.

BRISTOL MECHANICS' INSTITUTION.

THE first lecture to the Members of this Institution was recently delivered in the lecture-room of the Society; on which occasion more than 200 mechanics were present, as well as a number of gentlemen of the first respectability, who have interested themselves in the formation of the Institution.

Previous to the commencement of the lecture, the President, Charles Pinney, Esq., delivered an admirable address to the audience, in which he explained the objects of Mechanics' Institutions, and ably refuted the objections that have been brought against them. In the course of his remarks, Mr. Pinney took occasion to advert to the mistaken ideas which had prevailed respecting the effects of machinery, and shewed how much its employment benefitted, instead of injuring, the labouring classes. This benefit arose in two ways: first, by rendering articles of consumption cheaper, the labourer may purchase his necessaries with a smaller proportion of his earnings; and, secondly, the master manufacturers are thus enabled to employ additional hands, by engaging in new branches of industry. Since *stocking-frames* have superseded knitting, ten times as many persons are employed in manufacturing hosiery; because more people can now afford to buy stockings.

Since *Printing* has made writing in so much less request, those employed in the mechanical part of the production of books, are perhaps a thousand times more numerous than they were; because the number of readers has increased, in proportion to the greater facility of acquiring books; and it is an important fact, that those parts of the country which resisted the improvements in machinery, are now introducing them, from discovering their depressed state, compared with the favourable condition of those places which more judiciously availed themselves of their early addition.

After Mr. Pinney had finished his eloquent address, a gratuitous lecture upon Mechanics was delivered by Mr. T. Exley, who had kindly acceded to the wishes of the Committee, in undertaking its delivery. The lecture was delivered with much simplicity, and the exemplifications shewn with great neatness. A more attentive audience was never collected together, and it was interesting to observe the pleasurable emotion evinced by the numerous intelligent countenances, when any simple experiment at once brought to their minds the conviction of some demonstrable truth. The greatest order and propriety prevailed, and the Members separated highly gratified with their evening's instruction.

Upwards of 400 mechanics have already been admitted as Members: each Member pays 2*s*. 6*d*. per quarter. A library, consisting chiefly of presents, has been begun, and arrangements will soon be made for the regular delivery of lectures, upon such subjects as may be useful to the various classes of mechanics.

IPSWICH MECHANICS' INSTITUTION.

THE Anual Meeting of this Institution took place on Wednesday the 4th instant, and was attended by a very considerable proportion of the Members. It appears by the statement then made, that the property of the Institution consists of a pair of Jones's 18-inch globes, three cases of mathematical instruments, &c. and 141 volumes of books. The circulation of books commenced on the 20th of May last, and, during the past year, eight Lectures on various subjects have been delivered *by Members of the Institution*. The amount of subscriptions and donations for the year 1825, was £126. 8*s*. 5*d*. and the balance in the hands of the Treasurer £28. 2*s*. 10*d*. The books presented to the Institution amount to upwards of £54, and such as are permitted to be circulated, are very often out and in the hands of the Members. This perusal of the books will enable them to go over the different subjects that have been lectured on, and the necessarily concise statements in the lectures will be made clear to them by their own application and study. It is gratifying to observe the zeal and activity with which the Members of such an Institution as the present, endeavour to avail themselves of its advantages, notwithstanding their circumscribed means.

BRIGHTON MECHANICS' INSTITUTION.

MR. HINTON, of Chichester, delivered a lecture on Stenography, a few evenings since, to the senior Members of the Brighton Mechanics' Institution. After making a few introductory remarks, on the advantages resulting from a knowledge of the art, he proceeded to read some extracts from different authors, confirmatory of his opinion as to its general utility. He then briefly touched upon the history of Short-hand in this country; comparing, *en passant*, some of the most eminent systems with each other, and pointing out their peculiar merits and defects, more particularly in the construction of alphabets; referring to about half a dozen on a diagram for that purpose. The most practical method of forming an alphabet on mathematical principles was clearly pointed out, by reference to the diagram, containing a circle, with its divisions and sub-divisions, by which means each letter was reduced to *one simple stroke*, forming one of these divisions, yet completely distinct from each other.

Thus the common alphabet, which requires considerably more than 100 distinct motions of the pen, is completed by only 26, the number of letters in the alphabet.

The Lecturer then made some very appropriate remarks, relative to the omission of intermediate vowels; and, after giving a minute and satisfactory explanation of the principles of his system, which he illustrated by writing several examples, he concluded, by shewing that this very useful art might be easily acquired.

After the Lecture, several of the Members entered their names, as subscribers to Mr. Hinton's forthcoming work, on Stenography, and resolved to form a Class upon the system, as soon as possible.

PANARY FERMENTATION.

To the Editor of the Mechanic' Register.

SIR,—A short time since, I gave a description of the vinous fermentation; but there being something peculiar in that which accompanies the conversion of flour into bread, and is called the *panary fermentation*, perhaps, the following description will prove acceptable.

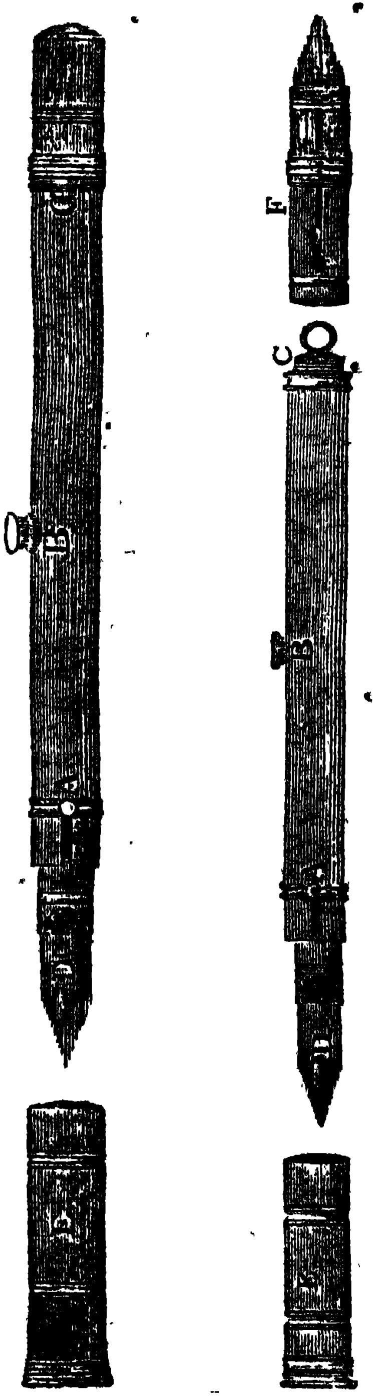
Bread, as every one knows, is made from flour. This is a compound of a small quantity of *mucilaginous saccharine matter*, readily dissolved in cold water; of much *fecula* or starch, which is insoluble in cold water, while it is soluble in hot, forming a solution viscid and gelatinous, likewise insoluble in alcohol and in ether, and forming, with iodine, combinations of various colours; and of a tough, elastic, grey substance, called *gluten*. Gluten has no taste; does not melt or lose its tenacity in the mouth, and when dried becomes brown and brittle; it is insoluble in water, alcohol, and ether; and is precipitated by *acetate* and *sub-acetate of lead*, by *muriate of tin*, and by several other re-agents. The superiority of the flour depends on the quantity of gluten it contains, and it will be shewn, presently, that it contributes to the porosity and lightness of the bread; hence, wheat-flour is best adapted for making it, as it contains the largest quantity.. When flour is kneaded together with water, it forms a tough paste, containing their principles very little altered, and not easily digested by the stomach. The application of heat, however, produces a greater change, rendering the compound more easy to masticate, as well as to digest.

This cake, however, is, in this state, heavy and tough, and is only made light by *leaven*. We must, therefore, mix two parts of water with three of flour. This flour paste may be regarded as merely a viscid and elastic tissue of *gluten*, the interstices of which are filled with fecula, albumen and sugar. If this be kept in a warm place for some time, its ingredients gradually re-act on each other, and a species of *fermentation* is established, and *alcohol*, *carbonic acid*, and lastly, *acetic acid*, are evolved. If the paste be now baked, it swells, becomes spongy, and acquires a sour and unpleasant taste. If a small portion of this paste, or, as it is now called, *leaven*, be added to new made paste, and properly kneaded, fermentation goes on more rapidly and equally, a quantity of *carbonic acid* is generated, the escape of which is prevented by the *gluten*, and forms a multitude of little cavities, which give lightness and porosity to the mass. When, however, leaven is employed, very great care is necessary in making the bread, for, in consequence of the great difficulty of adjusting the proportion of leaven, it is very apt to acquire a sour taste. On this account, *barm*, or *yeast*, as it is commonly called, is employed in most parts of Europe.

The dough having been fermented as above, is placed in an oven, at about the temperature of 450°, and allowed to remain until baked. Upon examining the bread, it will be found to have lost about one-fifth of its weight, owing to the evaporation of water, but this proportion will, of course, be varied by circumstances. Newly baked bread has a very grateful smell as well as taste, which are lost as it grows stale; this shews there is a chemical change constantly going on in bread, the nature of which is not understood. Bread differs very completely from the flour of which it is made, for none of the ingredients of the latter can now be discovered in it; it is much more miscible with water than dough, and on this circumstance its good qualities depend. It is not easy to explain the chemical changes which the flour has undergone; it appears certain that a quantity of water, or its elements, is consolidated and combined with the flour; the *gluten*, too, would seem to form a union with the starch and water, and give rise to a compound, upon which the nutritive qualities of bread depend.

Rye. TYRO.

SCHEFFER'S PATENT PENOGRAPH, OR SELF-SUPPLYING WRITING INSTRUMENT.



THE merit of this instrument is, that it contains ink and supplies itself as required, by which means the writer is enabled to use it for 10 or 12 hours without the aid of an inkstand, and with the same ease as when writing with a pencil. It is manufactured in gold or silver, in the usual size of a pencil-case, and so constructed, that either a metallic or quill nib may be applied.

When its use is required, take off the cover, E, and to prevent its being mislaid, place it on the top, C; then propel the lever, A, and press the projection B, which will cause the ink to flow into the pen, D. It may be well to wipe the nib when done with.

To replenish the penograph with ink, take off the top, C, and draw the stopple; then, with some clear ink, fill it nearly to the brim, in order to exclude the air, which will necessarily occasion a small portion of the ink to rise; this being removed, put on the top, and the instrument will be found to contain ink enough for 10 or 12 hours constant writing.

The nib may be drawn out and used at pleasure.

Should the projection or the lever become stiff, immerse the instrument in hot water a few minutes; afterwards allow the least drop of sweet oil to enter the inner part of the lever by means of a feather. If the channels through which the ink flows, be stopped, apply a fine brass wire, supplied for the purpose, which will remove any difficulty that can possibly arise in the use of the penograph, though it is presumed merely wiping it when done with will be sufficient.

COMBUSTION OF STEAM, &c.

To the Editor of the Mechanics' Register.

SIR,—YOUR Correspondent, "A MANUFACTURER," in his observations on the Combustion of Steam, inserted in your 58th Number, has proposed several Queries, which I proceed to answer, as follows:—

The first Query—"Can the steam do any possible good, unless decomposed?" Certainly not; on the contrary, it must diminish the combustion by abstracting a portion of heat, and occupying a space which would have been filled with atmospheric air; thus preventing a proper supply of *oxygen*;

and as combustion is considered as the general result of intense chemical action, and as in all common cases, combustion is the union of the inflammable body with the basis of *oxygen*, in consequence of which the heat and light are evolved in the form of flame; and as no chemical action takes place if the steam is not decomposed, change of form, &c. cannot therefore be the result; and, consequently, *caloric* is not liberated.

But if we consider the steam as decomposed, all difficulties immediately vanish; the *oxygen* combining with the *carbon* of the coal, and the *hydrogen* with the *oxygen* of the atmosphere; here intense chemical action takes place, and great heat must be the result.

The second Query—"What would be the effects of blasting a fire with a stream of *azote* or *carbonic acid?*" The extinguishing of combustion.—*Azote* will neither support combustion, nor is it combustible; and, if your Correspondent will fill a bladder with this gas, and attach a pipe to it, and place it at the bottom of a fire, upon his pressing the bladder so as to force the gas out, he will find that combustion ceases in those coals it comes in contact with.

What I have said of *azote* will apply also to *carbonic acid gas;* it will extinguish the flame.

The third Query—"What are the uses and effects of a common air bellows?" I am greatly surprised at this question: any one who knows the least of chemistry, must know that the use of the bellows is to supply a greater quantity of *oxygen*, the effect of which is a more intense combustion: thus, every old woman knows she ought to keep the bottom of her fire clear, that the air may come more freely in contact with the combustible.

Your Correspondent is perfectly correct, when he supposes "*atmospheric air* is not more a combustible than *steam*." Atmospheric air is not a *combustible body*, but a *supporter of combustion;* which, in the language of chemistry, signifies a body, that, when it enters into combination with some bodies, gives out heat and light.

I remain, Sir, your obedient servant,

Rye. TYRO.

OPTICAL PHENOMENON.

To the Editor of the Mechanics' Register.

SIR,—Feeling assured that you are desirous of promoting the knowledge of Science, and that your Register is ever open for that purpose, I am induced, through the medium of its columns, to request of some of your scientific readers, an elucidation of the following phenomenon, the account of which is extracted from the *Examiner* of December 11th, 1825.

"*Curious Fact.*—The following curious fact (says a correspondent) was recently pointed out to me by a friend:—Place an opaque object so that two shadows of equal density may be projected from it on a white surface, one by the moon, the other by a gas-light,—the shadow from the *moonlight* will be a *distinct red,* and that from the *gas*, a *greenish blue.* An obvious inference from this is, that, compared with each other, the *red rays* abound in the *gas*, and *green and blue* in the *moonlight.* The cause of these appearances is difficult of explanation, since neither of the lights produce such an effect when seen separately, and yet, each of the shadows is illuminated by the other light alone. I am inclined to think, that the colours common to both lights only diminish the intensity of the shadow, so that the super-abounding colour alone remains conspicuous. Certain colours are also considered, in a manner, to oppose each other, and are called *complementary colours;* and when either of these is suddenly excluded, the eye is supposed to become more sensible of the presence of its opponent."

I am, Sir,
Your obedient servant,
PETITOR.

DEPOSITION OF MOISTURE IN EXHAUSTED RECEIVERS.

To the Editor of the Mechanics' Register.

SIR,—Having read in your Register the report of Mr. Gowring's Second Lecture on Pneumatics, and observing a letter from a Member to him, wishing to know the cause of the cloudy appearance in the receiver, when a partial vacuum is made in the air-pump, I beg to transmit the following suggestion:—Supposing that, in the first few strokes of the pump, one-quarter of the air is taken out, the remaining three-quarters will be expanded to fill the vessel, and its *caloric* with it; then, as the moisture in the air was supported in solution by the caloric, and as the caloric is now divided, the moisture which it held must be liberated; and condensing, fall by its gravity, having lost its supporter. An analagous circumstance takes place in the crystallization of salts; most of which are more soluble in hot water than cold; for, on losing a part of the caloric, (and, probably, undergoing a change of electricity*) they crystallize as they cool, and become solid.

Yours, &c.
A. Pritchard.

QUERIES.

No. 40.

Sir,—Having a piece of land, about 400 feet long and 200 wide, which I am anxious to enclose by a wall instead of a wooden fence, I shall feel extremely obliged, if any of your intelligent and experienced readers would instruct me what is the *cheapest* way of building such a wall with other materials than bricks, as a brick wall, of that extent, will, of course, come too expensive. I am likewise anxious to have the new wall as durable, and as advantageous to fruit trees, as a brick one, if possible.

As black or dark colours attract more heat than light ones, may I also ask what is the *cheapest* method of preparing black or brown Water colour, to wash or paint with it garden walls or fences.

A. S. Victor.

Blackheath.

No. 41.

Sir,—An Old Subscriber would feel obliged, if any of your correspondents could give any good practical information as to the best method of preparing the plaster of Paris for fine casting, stereotyping, &c. Your's, &c.

I. F.

23d December, 1825.

ANSWERS TO QUERIES.

Query, No. 23, Page 108.

RE-LAYING AN ETCHING GROUND.

Wash the plate with spirits of turpentine, then warm it slightly, and pass a rag, dipt in water of potass, over the work, and wipe it off immediately; it will leave a slight sediment in the bottom of the lines. Then heat the plate as for the ordinary ground, rub a little of it on the margin, take a small quantity of it on the dabber, and go over the work lightly till it is all covered. The acid, when poured on, combines with the alkali in the lines, and blows up any portion of the ground which may have got in them.

G. P.

TO CORRESPONDENTS.

After attentively perusing Juvenis Admirator's second reply, we are inclined to think that very little difference of opinion exists, in reality, between him and his opponent, and we therefore cannot see the utility of prolonging the argument. While one of the disputants confines himself to rigid *theoretical rules*, and the other only to *practical results*, they may argue for an indefinite period without arriving at a satisfactory conclusion, even though both may be in the right.

We are obliged to Amicus for his friendly hint. The remark alluded to did not escape notice, and he will see that it has been correctly modified.

The plan suggested by Mr. Mollett has been for some time in progress, under the direction of the Library Committee, and, we believe, will be carried into effect almost immediately.

R. D. G. on The Theory of the Thunder-storm, in our next.

Communications have been received from J. J. H.—J. Taylor—S. P.—P. Danks—H. C.—Mr. Dewhurst—A Member of the L. M. I.—G. H.—W. W.—Tagitanus—R. Smith, &c.

Inquirendo's mode of transmitting his communication was extremely improper.

Our Correspondents are again requested to address their Letters to the Editor, at Messrs. Gifford & Co.'s, 52, Paternoster Row.

ERRATA.

In Mr. Cooper's Lecture, page 198, col. 2, line 4 from the bottom, for "39 grains" read "89 grains."

Page 199, col. 1, line 30, for "graduated" read "generated."

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* On placing a hot solution of alum near a mass of iron, I found that but one crystal had been formed, which was large and perfect; proving the magnetic influence of iron during crystallization.

THE LONDON
MECHANICS' REGISTER.

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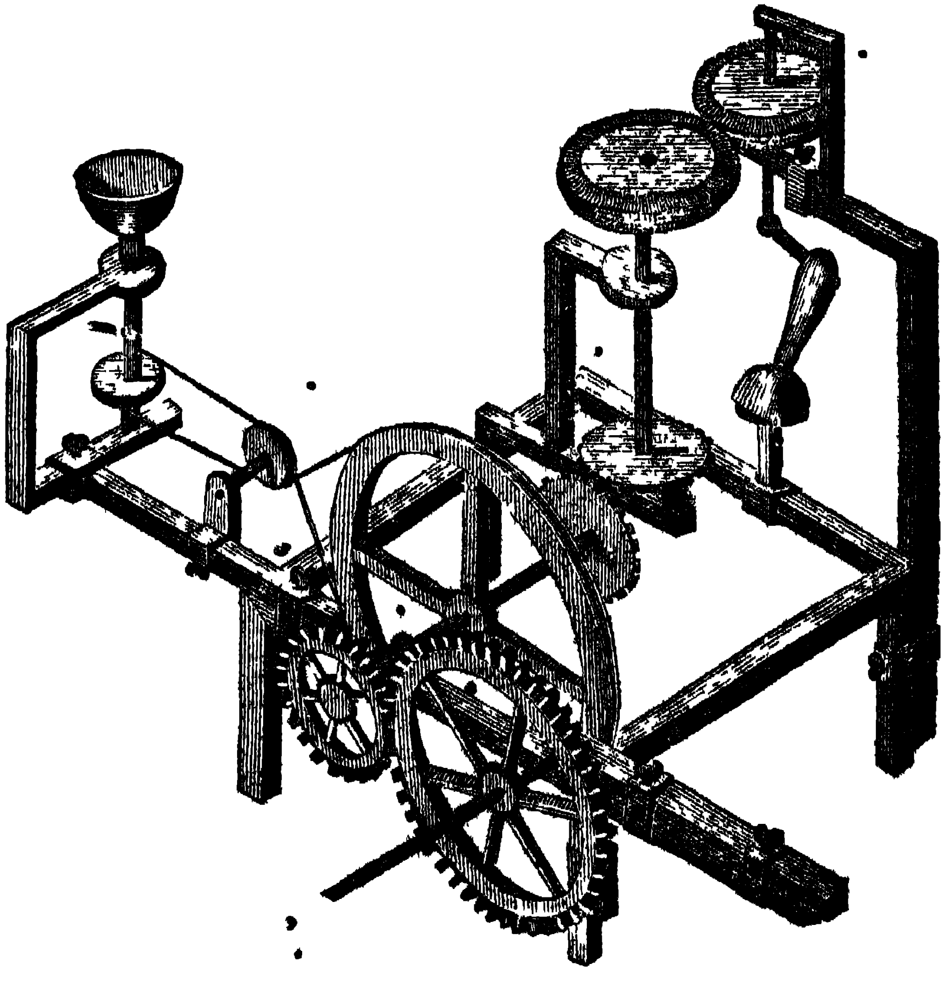
> "What stubbing, plowing, digging, and harrowing, is to land, that thinking, reflecting, examining, is to the mind. Each has its proper culture; and as the land that is suffered to lie waste and wild for a long time, will be overspread with brushwood, brambles, thorns, and such vegetables, which have neither use nor beauty, so there will not fail to sprout up in a neglected, uncultivated mind, a great number of prejudices and absurd opinions, which owe their origin partly to the soil itself, the passions, and imperfections of the mind of man, and partly to those seeds which chance to be scattered in it, by every wind of doctrine which the cunning of statesmen, the singularity of pedants, and the superstition of fools shall raise."—*Berkeley.*

N° 71.] SATURDAY, JANUARY 28, 1826. [Price 3*d.*

PROFESSOR FARISH'S ISOMETRICAL PERSPECTIVE.



PROFESSOR FARISH'S ISOMETRICAL PERSPECTIVE.

The Frontispiece of the present Number is an example of the application of Professor Farish's new system of perspective to the delineation of Machinery, to which it appears peculiarly adapted, though our readers will perceive, from the Professor's valuable explanation of his system, that it is capable of being applied much more extensively. The following paper is extracted from the Cambridge Philosophical Transactions, and from its great importance, we are induced to give it entire.

"In the course of Lectures which I deliver in the University of Cambridge, I exhibit models of almost all the more important machines which are in use in the manufactures of Britain.

"The number of these is so large, that had each of them been permanent and separate, on a scale requisite to make them work, and to explain them to my audience, I should, independently of other objections, have found it difficult to have procured a warehouse large enough to contain them. I procured therefore an apparatus, consisting of what may be called a system of the first principles of machinery; that is, the separate parts, of which machines consist. These are made chiefly of metal, so strong, that they may be sufficient to perform even heavy work: and so adapted to each other, that they may be put together at pleasure, in every form, which the particular occasion requires.

"Those parts are various: such as, loose brass wheels, the teeth of which all fit into one another: axes, of various lengths, on any part of which the wheel required may be fixed: bars, clamps, and frames; and whatever else might be necessary to build up the particular machines which are wanted for one lecture. These models may be taken down, and the parts built up again in a different form for the lecture of the following day. As these machines, thus constructed for a temporary purpose, have no permanent existence in themselves, it became necessary to make an accurate representation of them on paper, by which my assistants might know how to put them together without the necessity of my continual superintendance. This might have been done, by giving three orthographic plans of each; one on the horizontal plane, and two on vertical planes at right angles to each other. But such a method, though in some degree in use among artists, would be liable to great objections. It would be unintelligible to an inexperienced eye; and even to an artist, it shews but very imperfectly that which is most essential, the connexion of the different parts of the engine with one another; though it has the advantage of exhibiting the lines parallel to the planes, on which the orthographic projections are taken on a perfect scale.

"This will be easily understood, by supposing a cube to be the object represented. The ground-plan would be a square, representing both the upper and lower surfaces. And the two elevations would also be squares on two vertical planes, parallel to the other sides of the cube. The artist would have exhibited to him three squares; and he would have to discover how to put them together in the form of a cube, from the circumstance of there being two elevations, and a ground-plan. This method, therefore, giving so little assistance on so essential a point, I thought unsatisfactory.

"The taking a picture on the principles of common perspective, was the next expedient that suggested itself. And this might be adapted to the exhibition of a model, by taking a kind of bird's-eye view of the object, and having the plane of the picture, not as is most common in a drawing, perpendicular to the horizon, but to a line, drawn from the eye, to some principal part of the object. For example: in taking the picture of a cube, the eye might be placed in a distant point on the line which is formed by producing the diagonal of the cube. But to this common perspective, there are great objections. The lines, which in the cube itself are all equal, in the representation are unequal. So that it exhibits nothing like a scale. And to compute the proportions of the original from the representation, would be exceedingly difficult, and, for any useful purpose, impracticable: there is equal difficulty too, in computing the angles which represent the right angles of the cube. Neither does the representation appear correct, unless the eye of the person who looks at it be placed exactly in the point of sight. It is true, that as we are continually in the habit of looking at such perspective drawings, we get the habit of correcting, or rather overlooking the apparent errors which arise from the eye being out of the point of sight, and are therefore not struck with the appearance of incorrectness, which if we were unaccustomed to it, we should feel at once.

"The kind of perspective which is the subject of this paper, though liable in a slight degree to the last-mentioned inconvenience, till the eye becomes used to it, I found much better adapted to the exhibition of machinery; I therefore determined to adopt it, and set myself to investigate its principles, and to consider how it might most easily be brought into practice.

"It is preferable to the common perspective on many accounts, for such purposes. It is much easier and simpler in its principles. It is also, by the help of a common drawing-table, and two rulers, incomparably more easy, and, consequently, more accurate in its application; insomuch, that there is no difficulty in giving an almost perfectly correct representation of any object adapted to this perspective, to which the artist has access, if he has a very simple knowledge of its principles, and a little practice.

"It further represents the straight lines which lie in the three principal directions, all on the same scale. The right angles contained by such lines are always represented either by angles of 60 degrees, or the supplement of 60 degrees. And this, though it might look like an objection, will appear to be none on the first sight of a drawing on these principles, by any person who has ever looked at a picture. For he cannot for a moment have a doubt, that the angle represented is a right angle, on inspection.

"And we may observe further, that an angle of 60 degrees is the easiest to draw of any angle in nature. It may be instantly found by any person who has a pair of compasses, and understands the first proposition of Euclid. The representation, also, of circles and wheels, and of the manner in which they act on one another, is very simple and intelligible. The principles of this perspective which, from the peculiar circumstance of its exhibiting the lines in the three principal dimensions on the same scale, I denominate "*Isometrical*," will be understood from the following detail:

"Suppose a cube to be the object to be represented. The eye placed in the diagonal of the cube produced. The paper, on which the drawing is to be made, to be perpendicular to that diagonal, between the eye and the object, at a due proportional distance from each, according to the scale required. Let the distance of the eye, and consequently that of the paper, be indefinitely increased, so that the size of the object may be inconsiderable in respect of it.

"It is manifest, that all the lines drawn from any points of the object to the eye may be considered as perpendicular to the picture, which becomes, therefore, a species of orthographic projection. It is manifest, the projection will have for its outline, an equiangular and equilateral hexagon, with two vertical sides, and an angle at the top and bottom. The other three lines will be radii drawn from the centre to the lowest angle, and to the two alternate angles; and all these lines and sides will be equal to each other, both in the object and representation: and if any other lines parallel to any of the three radii should exist in the object, and be represented in the picture, their representations will bear to one another, and to the rest of the sides of the cube, the same proportion which the lines represented bear to one another in the object.

"If any one of them, therefore, be so taken as to bear any required proportion to *its* object, *e. g.* 1 to 8, as in my representations of my models, the others also will bear the same proportion to *their* objects; that is, the lines parallel to the three radii will be reduced to a scale.

"I omit the demonstration of this and some other points, partly for the sake of brevity, and partly because a geometrician will find no difficulty in demonstrating them himself from the nature of orthographic projection; and a person, who is not a geometrician, would have no interest in reading a demonstration.

"For the same reason, it is unnecessary to shew that the three angles at the centre are equal to one another, and each equal to 120 degrees, twice the angle of an equilateral triangle; and the angle contained between any radius and side is 60 degrees, the supplement of the above, and equal to the angle of an equilateral triangle. All this follows immediately from Euclid, B. IV. Prop. 15, on the inscription of a hexagon in a circle.

"In models and machines, most of the lines are actually in the three directions parallel to the sides of a cube, properly placed on the object. And the eye of the artist should be supposed to be placed at an indefinite distance, as before explained, in a diagonal of the cube produced."

[*To be continued.*]

LONDON MECHANICS' INSTITUTION.

MR. GOWRING'S LECTURE ON HYDROSTATICS.

SPECIFIC GRAVITIES OF SOLIDS LIGHTER THAN WATER, AND OF FLUIDS—HYDROMETERS—DESCRIPTION OF SIKES'S HYDROMETER — HYDRODYNAMICS — HYDRAULICS—MOBILITY OF FLUIDS—INCOMPRESSIBILITY OF WATER—ITS UPWARD, DOWNWARD, AND LATERAL PRESSURE—HYDROSTATIC PARADOX—CANALS, AQUEDUCTS, RESERVOIRS, &c. —SYPHON—WATER-WHEELS, &c.

WEDNESDAY, JANUARY 18TH.

MR. GOWRING continued his illustrations of the science of HYDROSTATICS, by observing, that as in his last lecture he had explained the method of obtaining the *specific gravities* of solid bodies *heavier* than water, he should now proceed to point out the manner of proceeding with solids *lighter* than an equal bulk of that fluid, and also with *fluids* in general, when it is wished to ascertain their specific gravities. If he were to proceed as before, by performing all the experiments connected with the subject, he feared he should exhaust the patience of his hearers, and he had, therefore, committed the principle facts to paper, in order that he might limit himself to as concise a description as possible, of this tedious, though highly important, part of Hydrostatics.

To ascertain the specific gravity of a solid, *lighter* than an equal bulk of water (and not *soluble* in it), the substance must have appended to it another which is *heavier*, to sink it. The weight which the latter loses in water must be previously ascertained, and this weight, subtracted from the total loss of weight of the two bodies, gives the divisor to be used as before directed; and if the weight in air of the light body be divided by this number, the quotient will be its specific gravity.

With *fluids* there are a variety of ways of proceeding. A bulb of glass for instance, is weighed first in water, and then in the fluid to be tried, and the difference in the buoyancy of the two fluids indicates the fact and proportion of a greater or less density. But by far the best method for this purpose, as well as for solids *soluble* in water (*salt* for instance), is to have a phial with a glass stopper, holding exactly a cubic inch, and to fill it exactly with the material to be examined. Of course, the weight of its contents will give the proportion between a cubic inch of water and the material in question. To secure an accurate result in all researches of this description, an accurate thermometer must accompany the experiments in every stage of the proceeding, in order to ascertain the temperature of the water (which must be pure or distilled), and also of the substances under examination.

The *hydrostatic balance* used in the last lecture was a very good one, but the beam was much heavier than some that are constructed, and the accuracy of the experiments was, in some degree, affected by a current of air. There are, however, other balances constructed with much greater nicety, the most delicate of which was invented by Mr. Herepath. But as a very delicate balance cannot easily be made portable, and protected from injury, different inventions have been resorted to for determining the specific gravities of liquids, particularly spirituous liquors, and these instruments are called *hydrometers*.

Mr. Gowring here exhibited two glass *hydrometers*, and illustrated their operation, by immersing them in *water* and in *alcohol*, and pointing out the manner in which they indicated the different specific gravities of the two fluids, by the different depths at which they floated. (Vide Vol. II. p. 322, for a further explanation of the common hydrometer.) These instruments are, however, very inaccurate, and are merely introduced to elucidate the principle upon which they act.

The principal instrument of this kind is the *hydrometer* sanctioned by Government, for determining the excise duties payable on all spirits throughout the United Kingdom, and known by the name of *Sikes's hydrometer.* This instrument has, on its upper stem, 10 principal divisions, each of which is subdivided into 5 parts. Its lower stem is made in a conical form, to receive 9 weights, numbered by tens, from 10 to 90; each representing so many principal divisions of the stem as its number indicates. Weight 90 finishes in water, at division 10 on the stem. Thus, the range of the instrument, consisting of one hundred principal divisions, sub-divided into fifths, is 500 from *alcohol* to *water.* The weight 60 sinks the hydrometer to P, or *proof*, on the stem, at 51° Fah. proving proof spirits; and a square weight, exactly 1-12th of the weight of the hydrometer, with the weight 60 appended to it, being put on the top of the instrument as a cap, sinks it in pure water to the same mark; proving its accuracy, and, at the same time, confirming the definition of *proof spirit*, given in the act of parliament for establishing this hydrometer, which states Sikes's proof spirit to weigh at 51° Fah. exactly 12-13ths of an equal bulk of distilled water. In using the *thermometer* accompanying the instrument, it is necessary that the samples, the vessels holding them, and the hydrometer itself, should all be of the same temperature, to insure a just result.

There are tables and a sliding rule, which shew *the concentrated strength* for the whole range of the instrument, from 30° to 80°, to a tenth of strength per cent.; so that 500 points of strength in each degree of temperature, between those limits, are obtained. But, by calculation, and a further sub-division of the stem, a greater degree of accuracy than even this may be obtained. The tables exhibit, on inspection, the curves or relative proportions, in which the several strengths are affected by a change of temperature, and shew that *strong* spirits are affected in a much higher degree, by a change of temperature, than *weak* ones. For example, spirits 70 per cent. over proof, vary 3 whole divisions, or 15 sub-divisions, from 30° to 40° of Fahrenheit; but below, or approaching to water, they do not vary one sub-division; and this obtains, in a higher degree, between 20° and 30°, than any other temperature; partly, because at that temperature only, can spirits be so high above proof.

It would be necessary here to call in the aid of chemistry, to explain one part of the preceding remarks, viz. the fact, that *water* and *spirits*, on mixture, are *concentrated*, or occupy a less space than when separate; that is, that a pint of spirits and a pint of water, *separate*, will not measure a quart, when *mixed*. This *concentration* is allowed for by the means already enumerated—the quantity of water to be added, to reduce spirits to *proof*, ascertained with precision—and the excise duty collected, with equal justice to Government and individuals.

Mr. Gowring then observed, that *pure* or *distilled water* is always to be considered as the standard in ascertaining the strength of spirits by the *hydrometer*, and he read the fifth section of the late Act for equalizing the weights and measures of the kingdom, which states, that a cubic inch of *distilled water*, weighed in air by brass weights, at a temperature of 62° Fah., the barometer being at 30 inches, is equal to 252,458 grains.

The Lecturer then performed several interesting experiments on the specific gravities of fluids, and of bodies immersed in them, and adverted to the fact which we have already stated upon other occasions, viz., that the human body is lighter than an equal bulk of water (Vide Vol. II., page 386, for an able illustration of this subject, by Dr. BIRKBECK).

The science of Hydrostatics has been distinguished into *Hydrostatics proper*, which treats of the pressure and equilibrium of fluids; *Hydrodynamics*, which relates to fluids in motion; and *Hydraulics*, which illustrates their motion through pipes, and treats of machines for the raising and moving of water.

From the extreme mobility of *water*, and of all other fluids, their particles are supposed to be *spherical*, and to this cause are attributed the properties of medical waters; the substances with which they are impregnated being supposed to occupy the spaces between their particles. Thus, if we pour water into a glass till it is so full that no more *water* can be added without causing it to overflow, a quantity of *salt* may be introduced, and when the water is saturated with salt, *powdered alum*, and afterwards *sugar* may be added, the whole of which will disappear, and become mixed with the water, without any augmentation of its bulk; from which it has been inferred, that the particles of these substances are also spherical (Vide Vol. II., page 308).

Mr. Gowring then adverted to the experiment of the *water-hammer*, which proves, that the particles of water are *hard*, and observed, that various attempts have been made to *compress* water; but the only experiments upon this subject which he considered at all satisfactory, were those of Mr. Canton, who employed the air-pump for producing the effect, and both by the *condensation* and *exhaustion* of air, conceived that he had compressed water one part in 21,740. It is true that Mr. Perkins states, that he has succeeded in compressing water 2½ per cent., but Mr. Gowring was of opinion, that his experiments were by no means decisive, and that, looking at the very trifling diminution of volume (if any) effected by Mr. Canton, water might, for all ordinary purposes, be considered *incompressible*.

Mr. Gowring then introduced a variety of experiments illustrative of the *upward*, *downward*, and *lateral* pressure of water, most of which we have already described in our reports of Mr. Partington's lectures on the same subject. The downward pressure of water was proved by placing a circular piece of wood at the bottom of a cylindrical glass vessel, and holding it down with a rod while the vessel was filled with water. Upon withdrawing the pressure of the rod, the piece of wood, though lighter than water, still remained at the bottom of the vessel, in consequence of the *downward* pressure of the water, till the fluid insinuated itself beneath the wood, when the *upward* pressure caused it to rise.

To illustrate the *upward* pressure of water, a piece of lead was suspended by a string, which passed through a narrow tube, and enabled the Lecturer to keep it fixed to the bottom of the tube. The tube was then immersed in a vessel of water, in which it was sunk to a depth equal to 8 or 10 times the thickness of the lead. Mr. Gowring then released the string, when the piece of lead, though so much heavier than the water, still remained attached to the small tube without sinking, owing to the upward pressure of the water below it; but, upon raising the tube a little, the lead immediately sunk, because its weight was then more than sufficient to counterbalance the pressure of the column of water in which it was immersed.

Mr. Gowring next proceeded to exemplify the *hydrostatic paradox*, that the pressure of water depends upon the *height*, and not upon the *weight* of the column, and that, therefore, a small quantity of water will counterbalance a body much heavier than itself. This was illustrated by an apparatus, consisting of a vessel, in the form of an inverted cone, with a valve at the bottom, which was kept closed by a lever, to which a weight of 4lbs. was attached. Upon pouring into this vessel rather more than 4lbs. of water, the pressure of the water overcame the resistance of the weight, and opened the valve, through which the water escaped. The experiment was repeated with a narrow cylindrical vessel, into which water was poured to the *same height* as before, when the resistance of the weight was again overcome, and the valve was opened, though, in this instance, the vessel contained a much less quantity of water than in the former. The machine called the *hydrostatic bellows* depends upon the same principle, and is formed of two circular pieces of wood, connected by leather, in a manner similar to the common bellows. A narrow perpendicular tube is attached to the instrument, and is bent horizontally at the bottom to conduct the water between the surfaces of the bellows. If heavy weights be placed on the upper surface and water be poured into the narrow tube, the weights will be raised, notwithstanding the quantity of water in the tube is very trifling, owing to the smallness of its diameter. The operation of this machine was exemplified by the Lecturer, who requested his assistant to stand upon the bellows, and pour water into the tube; when it was seen, that as soon as the narrow column reached to a sufficient height, it counterbalanced the great weight on the bellows, and lifted the assistant several inches.

Mr. Gowring then proceeded to point out the application of the same principle to the construction of Bramah's *hydraulic press* (an engraving and description of which, will be found in our Second Volume, pages 321, 322).

and introduced a variety of experiments and diagrams, to illustrate the motion and pressure of fluids, the construction of canals, aqueducts, reservoirs, flood-gates, &c. The Lecturer next adverted to the *syphon*, and described the principle of its operation; its probable agency in the production of intermittent springs; its effect, as exhibited in the philosophical toy, called the Cup of Tantalus, &c. (Vide Vol. II. pages 306, 307); and, after briefly noticing the Screw of Archimedes, the construction of chain-pumps, and the action of a stream of water, on overshot and undershot wheels, he concluded his interesting lecture, by stating that, as he had now explained the general principles of Hydrostatics, he should, on the following Wednesday evening, direct the attention of his hearers to the subject of *Magnetism*.

MR. M'WILLIAM then announced to the Students in Mr. Reynolds's *Geographical class*, that, in consequence of the indisposition of that gentleman, it was probable he would not be able to attend for some weeks. Under these circumstances, Mr. Christie, the Secretary, had kindly offered to supply his place, provided the pupils would attend on Tuesday evenings, instead of Mondays. Mr. M'William also stated, that there was now room enough to accommodate all the Members who had applied for admission into the MATHEMATICAL SCHOOL, and they might, therefore, attend for that purpose, on the following Tuesday evening.

MR. COOPER'S
SIXTEENTH LECTURE ON CHEMISTRY.

SILEX — ROCK-CRYSTAL — QUARTZ — FLINT, GRAVEL, SAND, &C.—MANUFACTURE OF GLASS—GREEN BOTTLE-GLASS—CROWN, PLATE, AND FLINT GLASS—LIQUOR OF FLINTS—EFFECTS OF FLUORIC ACID ON SILEX—FLUOR SPAR — ETCHING ON GLASS — SILICATED AND SUB-SILICATED FLUORIC ACID GAS—PRECIPITATION OF SILICA BY AMMONIA —ALUMINA — CLAYS — BRICK-MAKING—ALUM, OR SULPHATE OF ALUMINA—ITS DECOMPOSITION—MORDANTS — LAKES — WEDGWOOD'S PYROMETER — HOMBERG'S PYROPHORUS—EFFECTS OF THE OXY-HYDROGEN BLOW-PIPE—CONCLUSION.

FRIDAY, JANUARY 20TH.

MR. COOPER commenced the sixteenth and concluding lecture of the second division of his extensive course, by observing, that the first substance to which he should this evening request the attention of his hearers, was *silex*. This substance is found very abundantly in nature, and under a variety of forms; being sometimes crystalline, and, in other instances, assuming the appearance of *flint*, *gravel*, *sand*, &c. In the first of these forms, it occurs in six-sided prisms, terminating in three-sided summits, and crystals of this form are always called *rock-crystal*. This substance is used in the arts for a variety of purposes, particularly for the manufacture of the lenses called *pebbles*, and for lenses possessing a double refracting power, or the property of separating a single image of an object into two images. Another specimen of *rock-crystal* also appears in the form of six-sided prisms, but the apexes of this variety have also six sides. This kind of *rock-crystal* differs from the former, in being found *opaque*, whereas the other is *transparent*; and this opacity is supposed to be owing to the water deposited between the laminæ of the crystals. Mr. Cooper here exhibited a large specimen of transparent *rock-crystal*, corresponding exactly with the form he had described.

The substances already enumerated are those in which *silex* is produced by nature. Common *flint* may be considered as a very pure specimen of *quartz* (for *silex*, *quartz*, and *rock-crystal* are synonimous, the substances differing only in their external appearance, and *quartz* being the general name for this class of bodies), and the purest *sand* is another variety of the same substance, and may also be considered as a very pure specimen of *silex*.

None of these substances are, however, what is called, in chemical language, *silex*, which is procured by heating any of those bodies to fusion, in contact with *alkaline* matter; in which case, the *alkali* combines with the *pure silex*, forming a compound, for the most part soluble in water. Mr. Cooper here took a portion of the *sand*, which is collected at Lynn, in Norfolk, for the purpose of glass-making, and is not only brought to London, but is exported in considerable quantities, being the purest sand that is to be found. This *sand* the Lecturer mixed with *carbonate* *of potash*, using a very large quantity of the *alkali*, in proportion to the *sand* employed, and introduced the mixture into a crucible which was placed in the furnace, under which circumstances, he stated that the resulting compound would be, in a great measure, soluble in water.

Vitreous compositions, of all kinds, may be considered as mixtures of *sand* and *alkali*, in different proportions. The common *green bottle-glass* is manufactured from *sea-sand*, and the *alkali* obtained by burning the sea-weed, which produces *kelp*. This *kelp*, besides the uncombined *alkali*, contains a quantity of *neutral salts;* and the *silex* and *kelp* being subjected to an intense heat, a combination takes place, from which results the ordinary *green bottle-glass;* but in this case, it is evident that very impure materials are employed, and these impurities communicate to the glass its green colour. At a future period, when the metallic bodies are under consideration, we shall find that the metals give various colours to compounds of which they form a part, and it will be seen that, in the present instance, the green colour of the glass is owing to the presence of *iron*, which is found in the *kelp*, the *lime*, and other materials used in the process.

In the manufacture of the superior kinds of glass, purer materials are necessarily employed. In making *crown-glass*, for instance, the manufacturer uses the *Lynn sand*, already adverted to, and is more choice in the selection of his *kelp*, of which some use only the soluble portion. The commonest green glass, formerly used for glazing, is now seldom seen, as the manufacturer is aware of the cause of its colour, which he avoids by using better materials.

Plate-glass may be looked upon as identical with *crown-glass*, but the process is still more carefully attended to. *Lynn sand* is also used in its manufacture, and the *alkali* employed is either *carbonate of soda*, or *carbonate of potash*, prepared as pure as possible. The fusion of *crown* or *plate-glass* requires a very high temperature, because no substances enter into their composition which are capable of facilitating their fusion.

Flint-glass differs very materially in its composition from those already mentioned, and its specific gravity is much greater, from its containing a large quantity of *oxide of lead*. The general proportions of the substances forming *flint-glass* are, *sand* 3 parts, *litharge*, or *red-lead* 2 parts, and *carbonate of potash* 1 part. A mixture of these substances is much easier fused than either *plate* or *crown-glass*, and the *flint-glass* produced is more dense, and possesses a greater refracting power. In all these various kinds of glass, it will be observed, that *silex* or *sand* is the basis.

Mr. Cooper here stated that he would endeavour to exemplify the manufacture of *plate-glass*, by putting *sand* and *carbonate of potash* into a crucible, but he doubted whether, under the present circumstances, he should succeed in producing a vitreous compound. This was accordingly done, and the Lecturer observed that, during the combination of the *silex* with the *alkali*, the former exhibits decidedly *acid* properties, as it acts the part of an *acid* by producing a perfectly *neutral* compound with the *alkali*. It should also be observed, that the *carbonated alkali* employed, becomes decomposed during the process; the *potash* only uniting with the *silex*, while the *carbonic acid* is given off.

The crucible was soon afterwards taken red hot from the furnace, at which time its contents were in a state of violent effervescence, and *carbonic acid* was evolved in abundance. By continuing the application of heat for a sufficient length of time, glass of a very good quality would be formed, but soluble in water, in consequence of the excess of *alkali;* for the water, under the circumstances, will hold both the *silex* and the *potash* in solution, forming the *liquor of flints*, which is mentioned in old chemical works. The crucible was, some time afterwards, again taken out of the furnace, and a portion of the *glass* which was formed, was taken out in a state of fusion, and exhibited to the audience. The operation had been more successful than the Lecturer anticipated, but the glass was not perfectly pure, as the combination of some of the particles of sand had not been completely effected. The substance was, however, in every respect, similar to the common *plate-glass*.

It happens, not unfrequently, that *plate-glass* is found very liable to decay. An instance of this kind came under Mr. Cooper's observation a few days before, in which the circular glass plate of a plate electrical machine refused to act, though every possible means were used to excite it. The Lecturer examined this plate after it had stood by for a night, when he observed a slight efflorescence on its surface; and, upon applying his tongue to it, he found, that it consisted of *alkaline* matter, which the application of turmeric paper shewed to be *carbonate of soda*. He had, in other instances, seen *plate-glass* destroyed in the course of three years, and rendered almost opaque, by a kind of crystallization taking place within it, owing to an excess of *alkali* in its composition. These effects shew how necessary it is, that manufacturers should be careful not to employ too much *alkali*, which has the effect of diminishing the durability of the glass, though it gives it a more beautiful appearance when it is first manufactured.

Silex possesses the remarkable property of being insoluble in all the acids except one; for there is no acid that will attack *silex* except the *fluoric*. The *fluoric acid* is found in *fluor spar*, a substance to which we have formerly adverted, and which is a compound of *fluoric acid* and *lime*. The *fluoric acid* may be disengaged from the *fluor spar*, or *fluate of lime*, by acting upon it with *sulphuric acid*, which unites with the *lime*, and liberates the *fluoric acid;* and if this operation be performed in a *glass* vessel, we shall find, that the gas, as it rises, will corrode the glass, and completely destroy its transparency. Mr. Cooper performed this experiment, the result of which was, that the glass vessel was rendered perfectly opaque by the action of the *fluoric acid* in its interior surface, which was occasioned by the partial solution of the glass itself, owing to the siliceous matter it contained.

From this property of *fluoric acid*, it is employed for the purpose of corroding the surface of glass which is intended to be rendered rough, as in the interior of globular and other glasses, for lamps, &c. It is also used with considerable effect for producing ornamental figures on glass. This is effected by covering a piece of glass with wax, through which the design is traced, and the *fluoric acid* being then applied, either in a liquid or gaseous state, corrodes the glass without affecting the wax, and produces a perfect etching of the subject delineated. Mr. Cooper here exhibited a specimen of this kind, representing a Chinese scene, which had been drawn, during the afternoon, by an ingenious Member of the Institution, who, for want of a more appropriate instrument, had traced the design with the point of a pair of snuffers. When, however, it is wished to produce an opaque ground, and to exhibit the figures transparent, it is better to operate with the acid in a gaseous than in a liquid state. This operation may be performed by a very simple and economical process; for it is only necessary to form a small leaden trough, by turning up the edges of a piece of sheet-lead, with a hole in the middle to admit the gas from the vessel in which it is generated. The piece of glass, with the design traced upon it, is then laid upon the trough, and in a few minutes, the glass, where it is not protected by the wax, becomes corroded, and the design is effectually etched. Mr. Cooper here exhibited a piece of glass, on which the letters L M I, were formed in wax, and placed it on a leaden trough, over a vessel on the furnace, from which *fluoric acid*, in a gaseous state, was evolved. Upon examining the plate some time afterwards, the whole of its surface was found completely opaque, except where the letters were formed, but as the Lecturer, while proceeding with other subjects, had not minutely watched the progress of the operation, the wax had spread, and the letters were not very distinctly defined.

Mr. Cooper then observed, that, in order to shew that *silex* may be dissolved and held in solution by *fluoric acid*, he would endeavour to procure some *silicated fluoric acid gas*. To effect this, he mixed *sand* and pulverised *fluor spar*, in the proportion of two parts of the latter to one of the former, to which he added sulphuric acid, and introduced the mixture into a retort, the neck of which was then placed in communication with a vessel standing over mercury, and the heat of a spirit-lamp being applied to the retort, a quantity of *silicated fluoric acid gas* was given off, which soon displaced the mercury and filled the vessel. Now, it has been seen, that *fluoric acid gas* has a powerful action upon *glass;* but we here find that the gas, having become completely *saturated* with *silex* in the present experiment, has not the slightest effect on the *glass* vessel in which it is received.

The gaseous body thus obtained, possesses very extraordinary characters, for it is by far the heaviest of all known gases, and is rapidly absorbed by water. Mr. Cooper here passed up a small quantity of water to the *silicated fluoric acid gas*, when two phenomena were observable, viz., the rapid absorption of the gas, and the deposition of almost all the *silex* it had held in solution. It appears, therefore, that notwithstanding the great affinity of *silicated fluoric acid* for water, it lets fall the greater part of its *silica* during its absorption, which is evident from the opacity visible at the point of contact between the water and the gas; but, as it does not deposit the whole, the water holds both *fluoric acid* and *silica*, and therefore becomes a solution of *sub-silicated fluoric acid*.

The volatile alkali, *ammonia*, precipitates the whole of the *silica* from the *silicated fluoric acid;* but to effect this precipitation, it is necessary to employ exactly twice as much of the *alkali* as of the *acid*. Mr. Cooper here filled two vessels of different dimensions, the larger with *ammoniacal gas*, and the smaller with *silicated fluoric acid gas*, and placing the necks of the vessels together, the two transparent gases instantly assumed an opaque appearance; the *fluoric acid* entering into combination with the *ammonia*, and forming *fluate of ammonia*, while the whole of the *silica* was deposited, in a solid state, in the interior of the vessels.

From the action of *fluoric acid* on *glass*, it must be evident, that glass vessels are not adapted to contain it, and, therefore, leaden vessels are employed for that purpose. It should also be observed, that as this gas is injurious to the lungs, considerable caution is necessary to avoid inhaling it.

The next substance that will occupy our attention is *alumina*, which is the basis of all the *clays;* for every thing which partakes of a *clayey* character contains more or less of this substance. The difference between the various clays arises from the different proportions in which they are mixed with *silica*, *iron*, and other substances. The *yellow clay*, used for making bricks, for instance, contains a considerable quantity of *oxide of iron*. All *ochres*, whether red, yellow, or any other colour, may be considered as *clays* of different kinds, and the extensive utility of these various clays may be inferred from the numerous purposes to which they are applied, from the formation of the commonest brick, to the manufacture of the finest porcelain.

Amongst the remarkable characters of *clay*, is its *shrinkage* when exposed to a red heat, and this diminution is greater, in proportion to the increase of heat. This *shrinkage* is not alike in all *clays*, and it is therefore important to those who are engaged in manufactures where *clays* are used, to select those kinds which are least liable to it. It is well known, that if a hole in a fire-place be stopped with *clay*, it will crack, owing to the *shrinkage* of the substance. In the manufacture of *pottery*, this is a very important circumstance, and it is said that an allowance is made for *shrinkage*, by making a vessel 12 inches in size, which is intended to measure but 10 inches when completed. But this does not cure the grand evil, which arises from the *unequal shrinkage* of pottery ware, owing to the unequal mixture of iron and other substances in its composition. Large articles, manufactured for chemical purposes, frequently crack in different parts, in consequence of these inequalities.

This *shrinkage* frequently occurs in the manufacture of bricks, and, in this case, it is a matter of some consequence; for if bricks which are made in a 9-inch mould, and which ought to measure 9 inches, are found to be only 8 inches in length after they are burnt, it it evident that the purchaser loses one brick in nine. To exemplify the different degrees of *shrinkage*, which take place in different kinds of *clay*, the Lecturer produced pieces of common brick earth, tobacco-pipe clay, and the earth of which glass-house pots are composed. The three pieces were of exactly the same length, and were exposed to the same degree of heat in the furnace, from which they were some time afterwards withdrawn, when the piece of pipe-clay was unfortunately broken, but there was a very evident difference between the lengths of the other two pieces.

It was on the principle of the *shrinkage of clay* that Mr. Wedgwood constructed his *pyrometer*, for measuring intense degrees of heat. This instrument has fallen into disuse, from the difficulty of obtaining it; for it is said, that the secret of preparing the clay-pieces used with the apparatus, died with the inventor. The principle, however, was this:—Suppose a piece of *clay*, in its crude state, measures a certain determinate length, which is made the standard of comparison, and that this piece of clay, when exposed to a degree of heat necessary for the performance of any particular operation, shrinks to a certain extent, which is ascertained by applying it to a pair of conical calipers. We have now arrived at a method of ascertaining the same degree of heat upon any other occasion; for, by allowing a piece of the same clay to remain exposed to the action of heat, till it arrives at the same shrinkage, we know that we have exactly reached the required temperature. This, then, is the principle of Wedgwood's *pyrometer;* but it is necessary to take particular care that the pieces of *clay* are of the same length, and this may be ascertained as readily by the opening of a two-feet rule, as by Mr. Wedgwood's expensive apparatus.

Alumina forms the basis of that important article of commerce called *alum,* which is a salt, consisting of *aluminous earth, sulphuric acid, potash,* and *water.* To obtain *alumina* in a perfectly pure state, this salt is always employed, and the method of obtaining it is simply this:—The *alum* is first dissolved in water, and to the clear solution is added *carbonate of potash,* which seizes the *sulphuric acid,* and precipitates the *alumina,* while the *carbonic acid* is given off. The only difficulty which attends this operation, is to get rid of the whole of the fluid held by the bulky precipitate. Mr. Cooper produced this precipitate by adding *carbonate of potash* to a *solution of alum,* and observed that, if the precipitate were collected, and repeatedly washed and filtered, the pure *aluminous earth* would be obtained.

There is another article in the market, called *ammoniacal alum,* prepared in Scotland from an *alkaline* earth, which exists in combination with a kind of coal, called *alkalised shale.* This *shale* is subjected to heat with refuse coal, and the *alum* is found combined with *sulphuric acid,* but is not procured till an *alkali* is added. Urine is used for this purpose, and the result is, that the *alum* falls in a crystallized state. The *ammoniacal alum* thus obtained resembles *common alum,* but, by means of heat, we can drive off the *ammonia,* and leave the *alumina* behind.

Alum, or *sulphate of alumina,* is extensively employed by dyers in the production of colours, and is called a *mordant,* from its possessing the property of forming a basis, on which the colours are precipitated. All kinds of *lakes,* such as madder-lake, carmine-lake, Dutch-pink, &c. are *aluminous* substances, combined with colouring matter. If, for instance, instead of forming the *pure solution of alum* on the lecture-table, any kind of colouring matter, such as French berries, madder, Brazil-wood, &c. had been introduced into the solution, this colouring matter would have been precipitated by the *alum;* and it is upon this principle that all the colours, called *lakes,* depend; but they differ materially from the colours produced by *metallic oxides.*

Alum has so strong an affinity for moisture, that, if heated red-hot, it absorbs it while cooling; and still more rapidly after it is cooled. This absorption is sometimes so rapid, when the *alum* is in contact with combustible matter, that combustion is excited. Upon this principle the substance, called *Homberg's pyrophorus,* is formed, by mixing *alum* with flour, sugar, or starch, and exposing them to a red-heat. The mixture is placed in a small phial, coated with clay, and surrounded with sand, in a crucible. Mr. Cooper here produced a phial, containing a portion of this substance, which he had prepared by the process described, and the moment it was brought into contact with the atmosphere, by cracking the phial, it took fire. That this effect was not caused by the heat of the substance itself was evident, for the bottle was perfectly cool. When the atmosphere is in a very dry state, the pyrophorus sometimes fails to ignite, but its combustion is immediately effected by breathing upon it, which satisfactorily proves that the combustion is occasioned by its sudden absorption of moisture from the air.

Alum and *silica* are, of themselves, very infusible, as neither of them can be fused by the most intense heat of ordinary furnaces; but when mixed together, they have a greater tendency to fusion, especially if a portion of *alkaline* matter is present. *Lime,* for instance, causes them to fuse very readily, and the presence of this substance must, therefore, be carefully avoided in the finer kinds of manufacture. In making bricks, it is not so material, but it is frequently found, that large masses of bricks are fixed together, owing to the heterogeneous matter with which they are contaminated, and which renders them fusible. The Lecturer had seen some thousands of bricks rendered entirely useless from this cause.

Mr. Cooper now exposed some *alumina* to the intense heat produced by the flame of the *oxy-hydrogen blow-pipe.* The *alumina* emitted an excessively brilliant light, but exhibited not the slightest appearance of fusion; yet there is no difficulty in fusing the mixture of materials which exists in *tobacco-pipe clay.* The Lecturer demonstrated this fact, by exposing the ends of two pieces of broken *tobacco-pipe* to the flame of the mixed gases, by which the extremities were

fused, and the pieces of pipe were completely fixed together.

Mr. Cooper then observed, that he had concluded his remarks upon the *earthy* matters, and having, in the course of his Lectures on the science of CHEMISTRY, gone through the whole of the *simple bodies*, except the *metals*, he should now take leave of the audience for a short time. When the Committee, who had the management of the Society's affairs, required him to commence the third division of his course, he should direct his attention to an illustration of the metals, and till that period, he bade the Members FAREWELL!

The worthy Lecturer's temporary farewell was answered by loud and long-continued acclamations from the numerous audience, and he withdrew amidst a burst of applause, which amply testified their sense of his eminent talents as a Public Lecturer.

Mr. M'WILLIAM, who presided during the evening, then announced the Lectures for the following week, and also stated, that there was now sufficient room for the accommodation of all the Members who had applied for admission into the FRENCH CLASS; and they were therefore requested to attend at the usual hour, on the following Thursday evening.

LECTURES FOR NEXT WEEK.

Wednesday, February the 1st.—Mr. CHARLES LANE will, this evening, deliver a Lecture on the Classification of Human Knowledge.

Friday, February 3d.—Mr. TATUM's Lecture on Optics.

FURTHER CONSIDERATIONS ON THE THEORY OF THUNDER STORMS.

To the Editor of the Mechanics' Register.

SIR,—The suggestion of your correspondent G. H., page 187, for ascertaining whether the hypothesis of Mr. H., in his lecture on *hydrogen* be correct, is certainly ingenious, and may be worth a trial; but the failure of the experiment could not destroy the hypothesis, nor could its success establish its correctness, except by the reasoning of analogy.

G. H. proposes, that a jar filled with *nitrogen* be placed in a freezing mixture, and fired with an electric spark. The *nitrogen* with which the operator would fill the jar, would, in all possibility, be a very different compound from that which exists in the elevated regions of the atmosphere. The formation of *nitrogen*, if the theory of Mr. H. be correct, is occasioned by the agency of electricity. The two gases which form water are chemically combined, when the fluid is decomposed by evaporation, by their opposite states of electricity, and a new substance, viz., *nitrogen*, is the result. As it ascends, the chemical union becomes weaker, in consequence of a diminution of atmospheric pressure, and absence of radiated heat; but, with these causes, a change in its state of electricity is inevitable, which G. H. seems to have overlooked.

Your correspondent is doubtless aware, that water, evaporated by artificial heat, carries off electricity in abundance; but it would be idle to expect, that its redundant state of electricity shall accompany it to the higher regions. A change is every moment taking place in its ascent. The steam is either held in solution by the *caloric* of the atmosphere, or is decomposed to its original elements, and in either case it is interchanging with all surrounding bodies a redundancy or deficiency of electricity. With the nitrogen of the atmosphere formed by the mixed gases of evaporated water, a similar change in its state of electricity must occur. I can conceive the possibility of *nitrogen* at the surface of the earth, being a substance of an almost opposite nature at the altitude of a mile, although its component parts be exactly the same, merely in consequence of the mysterious and unknown change in its state of electricity.

G. H. has, through the whole of his letter, alluded to the combustion of hydrogen *alone*, without once referring to its combination with *oxygen*, which is indispensable, and without which, the theory of a thunder storm, by the explosion of gas, would be absurd. I do not charge this as a wilful omission on the part of your correspondent; the tone of fair argument and candour adopted in his sensible remarks, renders this unlikely; but *this* is the most essential part of the hypothesis, and ought never to be lost sight of. Mr. H., as I previously stated, asserts, that the noise of thunder is occasioned by explosion of the *mixed* gases, while the *silent* lightning of summer is occasioned by the combustion of *hydrogen*, which, of course, must be in the presence of some *oxygen* also. If bubbles of *hydrogen* be ignited in soap-suds, they will inflame without report, which I attribute to the comparative slowness of its combustion, by which a vacuum is generally formed, and as gradually filled by the atmosphere; while the instantaneous explosion of the mixed gases occasions a sudden vacuum, which is as suddenly filled, and the consequent concussion of the atmosphere occasions the report.

Whether this theory of the thunder-storm be correct, or not, I believe the suggestion, that atmospheric air is formed by the decomposition of evaporated waters, to be perfectly novel, and I am certain that it is plausible and ingenious. If the learned and worthy President of the Mechanics' Institution would favour your readers with his opinions on this subject, they could not fail to be highly gratifying. Every important discovery in science must originate either in conjecture or chance. It is by submitting our conjectures on matters which cannot be proved by actual experiment, to the test of philosophic scrutiny, that their justness must be established or subverted.

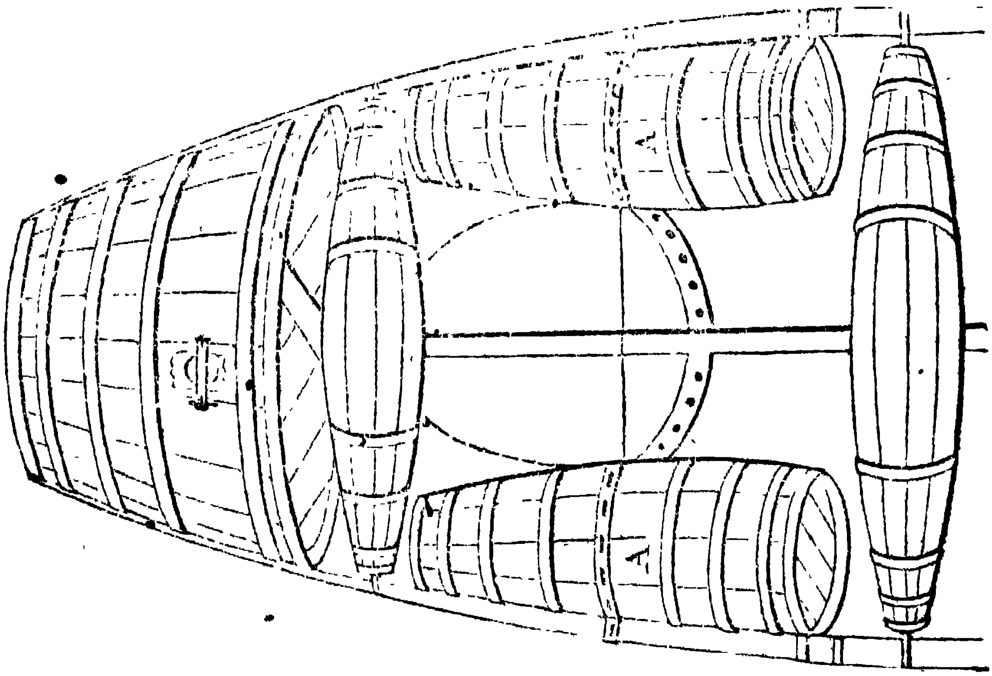
I am, Sir,
Your most obedient servant,
R. D. G.

Southampton Place, Russell Square, January 17, 1826.

PLAN FOR A LIFE BOAT.

To the Editor of the Mechanics' Register.

SIR,—Perfection is rarely to be met with by any one in the first attempt at any thing new; it cannot therefore be expected from your humble correspondent, W. W. I will just observe that I am no boatman, but since I sent you my suggestion for a Life-boat, I have thought that perhaps the boat would ride steadier if it was to have a seat on each side, instead of having them all cross-ways.

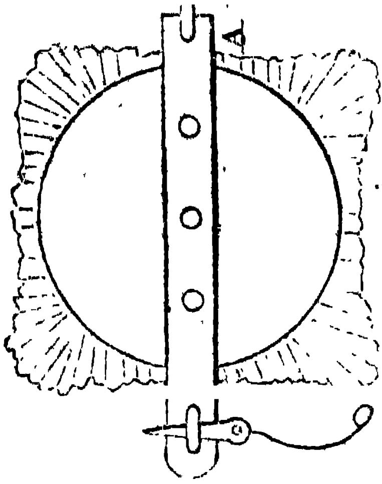


I propose to have a sufficient number of cross-seats for the rowers, and the after part of the boat to be fitted up as in the sketch; I thought it might be less liable to upset in this way, than in the other. My circumstances will not allow me to make one of each for trial, shall therefore leave it to the Public; and should it be tried, time and experience alone will prove, whether there is any merit due to the humble endeavour of, Sir,

Your constant reader,
W. W.

10, *Clift Street, New North Road.*

P. S.—The bung in the former diagram was not shown quite correctly; it should cross the staves. I have endeavoured to represent it on a larger scale, in order that it may be seen better.



The bung must be rivetted to a thin plate of wrought iron that crosses it, and be made secure to a staple, and work on it as on a hinge at A, and at the other end it must go over another staple, and be fastened down with a wooden pin; the pin having a small cord or chain to prevent it from being lost.

OIL FOR CHRONOMETERS AND WATCHES.

To the Editor of the Mechanics' Register.

SIR.—Having, at the request of a chronometer and watch-maker, undertaken an analysis of *olive oil*, that it might be obtained *entirely* applicable to *chronometers* and *watches* (the investigation of which has occupied a considerable portion of time), and the result being *opposite* to an opinion generally entertained by the trade, I have felt it incumbent on me to transmit to you the result, to be presented to the public, with your approbation, through the medium of the Mechanics' Register.

The mode generally adopted by the chronometer and watch-makers for the selecting of oil, is to expose flask or olive oil to a low temperature, that a part may become *solidified* or *frozen*, which part they separate from that which remains *fluid*, as being inapplicable to chronometers, &c. and the *fluid portion* is preserved, as possessing every good quality: that this mode or decision is not well-founded, will be seen in the sequel of this letter. Had the fluid (a substance to which the very common fat oil is preferable) been rejected, and the congealed or frozen part preserved, I am confident (by experiment) that the objections hitherto urged against *flask* or *olive oil* would not have been so general: wherefore, I would advise those who use the non-purified or flask olive-oil, to select, invariably, the *frozen* or *solid* part.

That oil frozen or congealed, can impede the motion of the works, requires no reply, since nothing can be more nugatory. Moreover, although the solid or frozen part of flask olive-oil be that only which is applicable to chronometers, &c. nevertheless, it is not entirely so—*i. e.* both will *clog*, corrode, and become rancid; the *fluid* in a shorter period than the *solid*.

I purpose therefore, stating, as briefly as possible, the substances to be met with in olive-oil, for the justification of my opinion; and, more especially, to demonstrate that the mechanical mode of *washing*, &c. *injures*, rather than *purifies*, the oil.

Olive-oil contains the substances, *stearïn*, *elaïn*, and *mucilaginous matter*. Their properties are as follows:—

Elaïn, when pure, is inodorous and insipid; it resembles *vegetable oil*, and is *fluid* at the temperature of rature of about 45°.

Stearïn, sometimes, crystallizes in small needles, but has commonly the appearance of *wax; white* and *brittle*. When pure, it is insipid and inodorous; and is *fluid, only*, at the tempe- about 109°.

Olive-oil lets fall, on standing, a quantity of *mucilaginous* matter, to the presence of which has been ascribed, and very justly, the cause of its rancidity; its action upon the metals, as a solvent, &c. By way of demonstration, the following very simple experiment (especially at this season of the year) may be employed:—Let a flask of *fluid olive-oil*, free from dust, &c. be exposed to a temperature sufficiently low to occasion *congelation;* after which, pour off the *liquid* part into a shallow glass vessel; put an equivalent quantity (by weight) of the *solid* part into a similar vessel, and expose them to the action of the atmosphere, loosely covered with paper; after they have stood some months let them be examined, when it will be found that a considerable deposition has taken place in the vessel containing the *fluid;* the oil, partially rancid and thick, having an offensive smell, an acrid taste, and a change of colour (a property by which the apexes of the pivots are corroded, and the several concavities *enlarged,* and filled with a mucilaginous substance); to this *change* the congealed part is subject, requiring a *multiplied* period for a similar decomposition.

Again, that the *congealed* part of oil is preferable to the *fluid,* may be thus exemplified:—Let a number of phial bottles, containing samples of different oils, be exposed to a low temperature, and, upon examination, it will be found that the oils of finer quality are *congealed,* whilst the most rancid or inferior are scarcely affected by it.

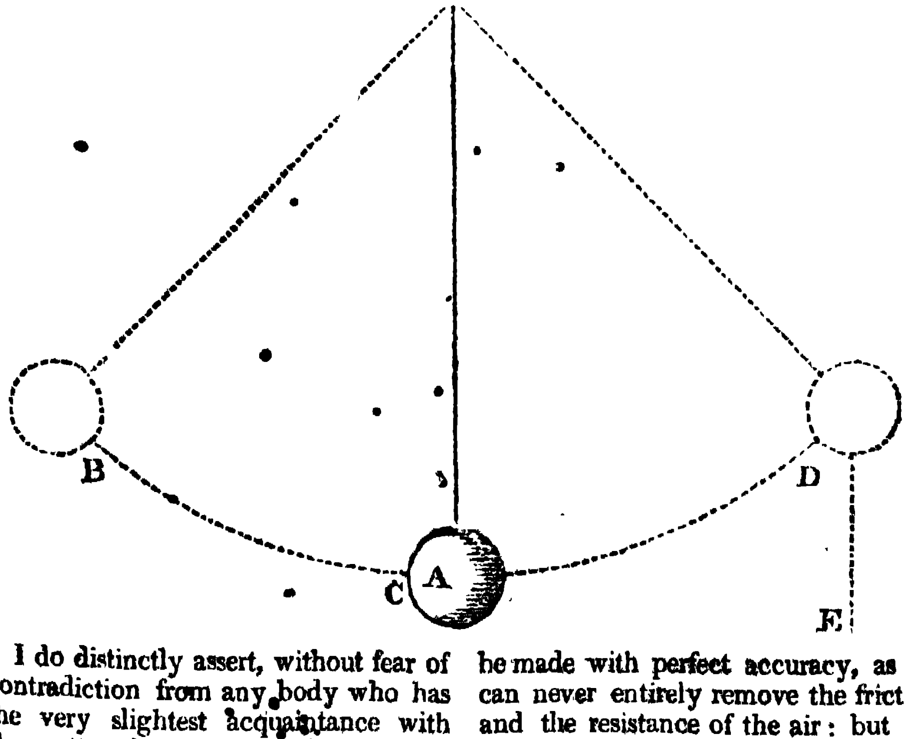
Finally, the *olive-oil,* which forms the *result* of my investigation, I have, by way of distinction, designated the "*ne plus ultra.*" It is deprived of every particle of *heterogeneous* matter; will not *clog,* and has no action upon *metal.* Samples of the oil, standing over *metal,* are at my dwelling, for the inspection of gentlemen of the trade, who may favour me with a visit.

I remain, most respectfully, Sir,
Your most obedient servant,
GEORGE WHIPPLE.
136, *St. John Street, Clerkenwell.*

LAWS OF MOTION.

To the Editor of the Mechanics' Register.

SIR,—I arrived at home at a late hour last night, and this morning, on looking over some Numbers of your Register, which had been left during my absence, was much amused and delighted at the epistle of N. R. (page 155). Without at present noticing the beginning of his most sage composition, I shall proceed at once to grapple with him on the subject of the oscillation of the simple pendulum. In order that I may not swell my letter to an unnecessary size, as he has done, I shall refer to his own figure.



I do distinctly assert, without fear of contradiction from any body who has the very slightest acquaintance with the matter, that were *friction* removed and the experiment made *in vacuo,* the ball "would rise 45° on the other side, as at B;" the experiment cannot be made with perfect accuracy, as we can never entirely remove the friction and the resistance of the air: but the more perfect the experiment, the more nearly does the arc of ascent approximate to the other.

Your Correspondent N. R. is right a

to the *fact*, but in mistaking the *cause*, he has shown his entire ignorance on the subject. *Gravity* acts precisely in the same manner on the ball, on whichever side of A it happens to be; it constantly tends to draw the body down to A. Suppose the ball at D; then if the experiment be made *in vacuo*, in falling through the arc D C, it acquires a sufficient velocity to carry it up B C. If the body did not rise to B, (*in vacuo*, &c.) then the force of gravity would affect the ball differently on the side B. C.

I hope N. R. will accept my thanks for the witty remarks in his letter, as they have furnished me with a subject for laughter; I must, however, remind him, that to refute a sneer is impossible; the only way is to treat it with silent contempt: his letter has altered my opinion certainly in one respect; instead of a little more reading on the subject, I think he stands in need of a great deal.

Your constant reader,

Nottingham. F. M.

FORM OF THE ULTIMATE PARTICLES OF WATER.

To the Editor of the Mechanics' Register.

SIR,—Observing in your Register (page 206) some remarks on the form of the ultimate particles of water, I will, with your permission, offer a few observations thereon.

That I may be perspicuous without encroaching too much on your pages, I will number my paragraphs to correspond with those of W. Yod. T., begging your readers to refer to his letter for the propositions themselves.

1. This appears to proceed on the supposition, that the spherical particles *are themselves compressible*, a position which, I think, your correspondent will not insist on.

It is pretty generally thought, that the particles of bodies are not in absolute contact, but that they are kept asunder by a repulsive force, which must be overcome before the parts can be brought into a closer state of aggregation. For, in relation to spheres, were they in absolute contact, it is evident, they could not approach nearer, and therefore, could not be compressed at all.

2. It requires, in my opinion, few arguments to prove, that the particles of water possess great freedom of motion among each other. For, if this were not the fact, how could we so easily insert any substance among their particles; or why should they so readily flow down the slightest descent?

3. Various forms of crystals may be constructed with spheres: as, 4 will form a *tetraedron*, 8, a *cube*, 6, an *octagon*, &c.; hence, if the crystals, formed by the aggregation of spheres, be joined at certain angles, they will occupy a greater space than the same number of spheres arranged in parallel strata. In ice, the crystals are found to be filaments, joined at angles of 60°.

4. If I rightly understand this proposition, it appears to be founded on the same supposition as the first, viz., that the ultimate particles are compressible, and consequently, capable of receiving different forms.

On the propositions in favour of the *octaedral* form, your correspondent's own words appear to me a sufficient refutation of his opinion: he says, "they would all fit into each other and form a compact body." Now, I think it will be allowed, that this compact body would be very different from the nature of water, which is a fluid; the parts of which are easily separable from each other. With respect to the expansion of water in freezing, I have shewn, that it may be accounted for on the supposition of *spherical*, as well as by that of *octaedral* formed particles.

Yours, respectfully,

S. P.

QUERY.

No. 42.

A person having a vessel containing ten gallons of brandy, first takes out one gallon, and then fills the vessel with water: he takes out a gallon of this mixture, and again fills it up with water; repeating the operation until he has taken out ten gallons, and put in ten gallons of water. The question is, how much brandy is there left in this mixture at last? G. MORLEY.

Answers to Correspondents in our next Number.

THE LONDON
MECHANICS' REGISTER.

> "Young people are apt to think they have so much time before them, that they may squander what they please of it, and yet have enough left; as great fortunes have frequently seduced people to a ruinous profusion."
>
> Lord Chesterfield.

No. 72.] SATURDAY, FEBRUARY 4, 1826. [Price 3*d*.

PROFESSOR FARISH'S ISOMETRICAL PERSPECTIVE.

Fig 2

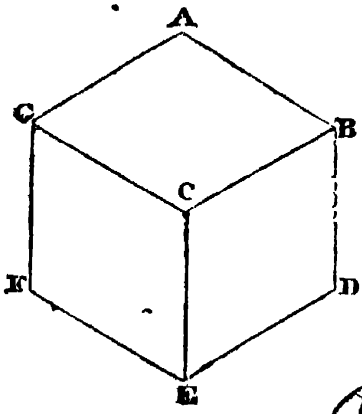
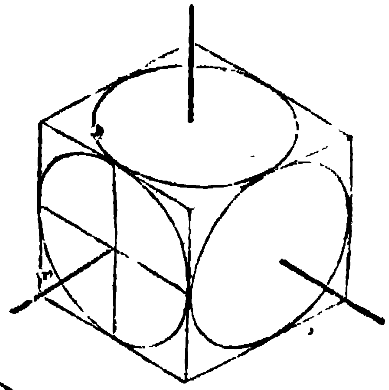


Fig 3



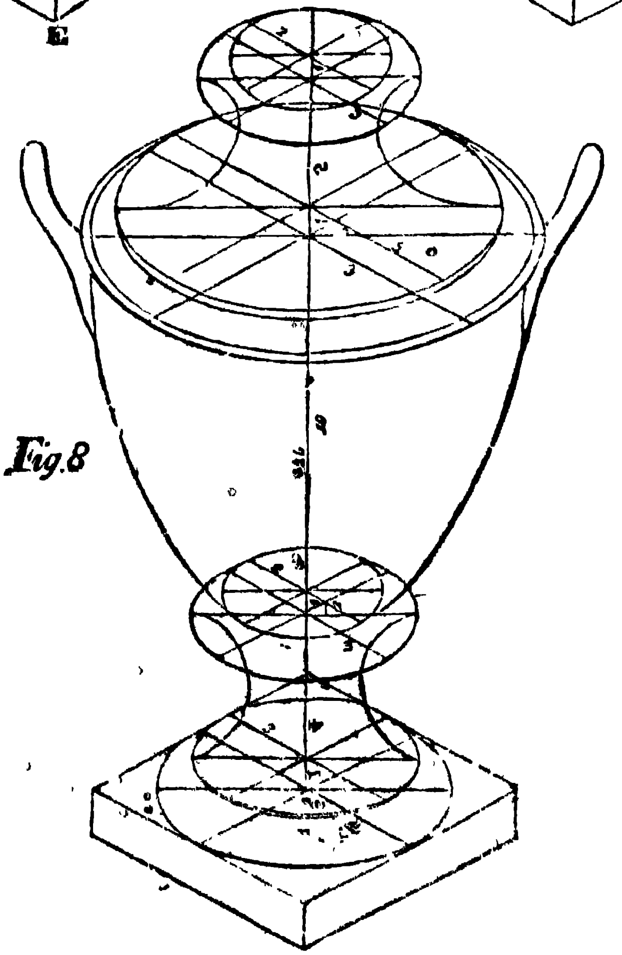


Fig. 8

PROFESSOR FARISH'S ISOMETRICAL PERSPECTIVE

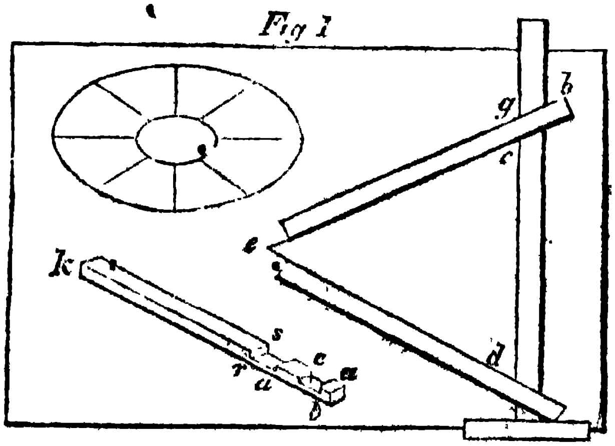
(Continued from Page 228.)

In the course of Professor Farish's introductory remarks, given in our last Number, he observes (page 227) that the Isometrical Perspective is "much easier and simpler in its principles, and is also, by the help of a common drawing-table, incomparably more easy, and, consequently, more accurate in its application," &c. In a note to these observations, the Professor introduces the following account of the construction of the drawing-table:—

"It is unnecessary to describe the drawing-table any further than by observing, that it ought to be so contrived, as to keep the paper steady on which the drawing is to be made.

"Here should be a ruler in the form of the letter T, to slide on one side of the drawing-table. The ruler should be kept, by small prominences on the under side, from being in immediate contact with the paper, to prevent its blotting the fresh drawn lines as it slides over them. And a second ruler, by means of a groove near one end on its under side, should be made to slide on the first. The groove should be wider than the breadth of the first ruler, and so fitted, that the second may, at pleasure, be put into either of the two positions represented in the plate, fig. 1, so as to contain, with the former ruler, in either position, an angle of 60 degrees.

Fig 1

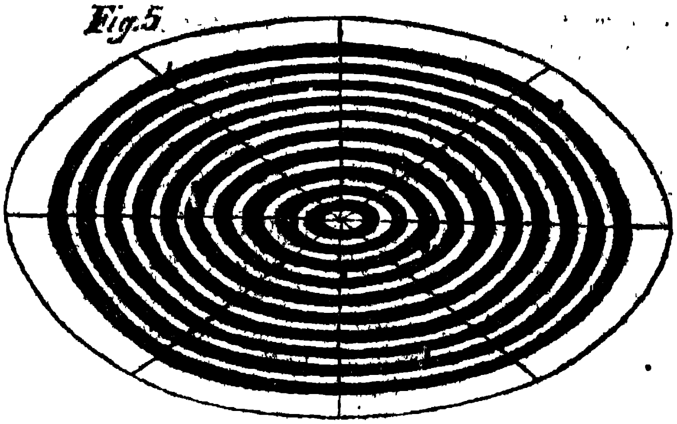


"The groove should be of such a size, that when its shoulders *a* and *d* are in contact with, and rest against the edges of the first ruler, the edge of the second ruler should coincide with *d e*, the side of an equilateral triangle described on *d g*, a portion of the edge of the first ruler; and when the shoulders *b* and *c* rest against the edge of the first ruler, the edge of the second should lie along *g e*, the other side of the equilateral triangle. The second ruler should have a little foot at *k*; for the same purpose as the prominences on the first ruler, and both of them should have their edges divided into inches, and tenths, or eighths of inches.

"It would be convenient if the second ruler had also another groove *r s*, so formed that when the shoulders *r* and *s* are in contact with the edges of the first ruler, the second should be at right angles to it. For representing circles in their proper positions, the writer made use of the inner edge of rims cut out from cards, into isometrical ellipses, as represented in the figure; of these, he had a series of different sizes, corresponding to his wheels.

"Such a series might be cut by help of the concentric ellipses in figure 5, but he thinks that it would be an easier way to make use of that set of concentric ellipses as they stand, by putting them in the proper place under the picture, if the paper on which the drawing is made, be thin enough for the lines to be traced through, as by the help of them the several concentric circles will go to the representation of one which might be drawn at once. It is difficult to execute them separately, with sufficient accuracy to make them correspond. For this purpose, a separate plate of figure 5 should be had, and one edge of the paper on the drawing-table should be loose, to admit of the concentric ellipses being slid under it to the proper place, as described, p. 243.

Fig. 5.



Professor Farish then proceeds to illustrate his system, by the following definitions:—

DEFINITIONS.

"The last-mentioned line (the diagonal of the cube produced) may be called the *line of sight*.

"Let a certain point be assumed in the object, as, for example, c, fig. 2, (Vide Frontispiece), and be represented in the picture, to be called, the *regulating point*. Through that point on the picture may be drawn a vertical line, C E, and two others, C B, C G, containing with it, and with one another, angles of 120°, to be called the *isometrical lines*, to be distinguished from one another by the names of the *vertical*, the *dexter*, and the *sinister* lines. And the two latter may be called by a common name—the *horizontal isometrical* lines. Any other lines, parallel to them, may be called respectively by the same names. The plane passing through the dexter, and vertical lines, may be called the *dexter isometrical plane;* that passing through the vertical and sinister lines, the *sinister plane;* and that through the dexter and sinister lines, the *horizontal plane*.

"By the use of the simple apparatus described above, the representation of these lines in the objects may be drawn on the picture, and measured to a scale, with the utmost facility, the point at the extremity being first found, or assumed. The position of any point in the picture may be easily found, by measuring its three distances, namely, first its perpendicular distance from the *regulating horizontal plane* (that is, the horizontal plane passing through the regulating point); secondly, the perpendicular distance of that point where the perpendicular meets the horizontal plane, from the regulating dexter line; and, thirdly, of the point, where that perpendicular meets the dexter line from the regulating point; and then taking those distances reduced to the scale; first, along the dexter line; secondly, along the sinister line, and, thirdly, along the vertical line in the picture. These three may be called the *dexter distance* of the point, its *sinister distance*, and its *altitude*. And it is manifest they need not be taken in this order, but in any other that may be more convenient to the artist; there being six ways in which this operation may be varied.

"If any point in the same isometrical plane, with the point required to be found, is already represented in the picture, that point may be assumed as a new regulating point, and the point required found by taking two distances; and if the new assumed regulating point is in the same isometrical line with the point, it is found by taking only one distance. And this last simple operation will be found in practice all that is necessary for the determination of most of the points required. Thus, any parellelopided, or any frame work, or other object with rafters, or lines lying in the isometrical directions, may be most easily and accurately exhibited on any scale required. But if it be necessary to represent lines in other directions, they will not be on the same scale, but may be exhibited, if straight lines, by finding the extremities as above, and drawing the line from one to the other; or sometimes more readily in practice by help of an ellipse, as hereafter described.

"If a curved line be required, several points may be found, sufficient to guide the artist to that degree of exactness which is required.

"The method of exhibiting the representations of any machines or objects, the lines of which lie, as they generally do, in the isometrical directions; that is, parallel to the three directions of the lines of the cube, is as has been already shewn; and likewise the mode of representing any other straight lines, by finding their extremities; or curved lines, by finding a number of points.

"But in representing machines and models, there are not only isometrical lines, but also many wheels working into each other, to be represented. These, for the most part, lie in the isometrical planes. And it is fortunate that the picture of a circle, in any one of these planes, is always an ellipse of the same form, whether the plane be horizontal, dexter, or sinister; yet they are easily distinguished from each other by the position in which they are placed on their axle, which is an isometrical line, always coinciding with the minor axis of the ellipse.

"This will be obvious from considering the picture of a cube with a circle inscribed in each of its planes, fig. 3 (Vide Frontispiece), and considering these circles as wheels on an axle. The two other lines (or spokes of the wheel) in the ellipse, which are drawn respectively through the opposite points of contact of the circle with the circumscribing figure, are isometrical lines also; for the points of contact bisect the sides of the circumscribing parallelogram, and, therefore, the lines are parallel to the other sides. They give, likewise, the true diameter of the wheels, reduced to the scale required. It further appears, from the nature of orthographic projection, that the major axis of the ellipse is to the minor axis, as the longer to the shorter diagonal of the circumscribing parallelogram, that is (since the shorter diagonal divides it into two equilateral triangles), as the square root of three to one; as appears from Euclid, Lib. I. Prop. 47: and since the sum of the squares of the conjugate diameters in an ellipse is always the same, if we put $\sqrt{1}$ for the minor axis, the $\sqrt{3}$ for the major, and i for the isometrical diameter, we shall have $2\,i^2 = 1 + 3, = 4$, and $i = \sqrt{2}$.

"Therefore the minor axis, the isometrical diameter, and the major axis, may be represented respectively, by $\sqrt{1}$, $\sqrt{2}$, $\sqrt{3}$, or nearly by 1, 1·4142, 1·7321; or more simply, though not so nearly, by 28, 40, 49.

"These lines may be geometrically exhibited by the following construction:

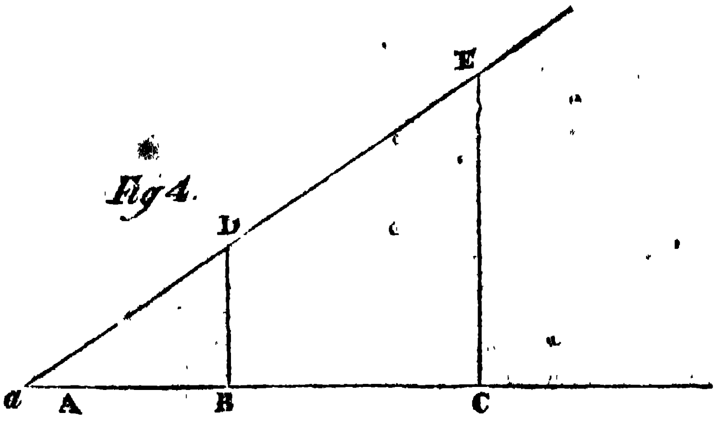


Fig 4.

"Let A B, fig. 4, be equal to B D, and the angle at B, a right angle. In B A produced, take B *a* = to A D draw *a* D, and produce both it and *a* B. Then will B D, B *a*, and *a* D, be respectively to one another, as $\sqrt{1}$, $\sqrt{2}$, $\sqrt{3}$ by Euclid I. 47. Therefore, if *a* C be taken equal to the isometrical diameter of the ellipse required, E C drawn perpendicular to it will be the minor axis, and *a* K the major axis. The ellipse itself, therefore, may be drawn by an elliptic compass, as that instrument may be properly set, if the major and minor axes are known. If it is to represent a wheel on an axle, care must be taken to make the minor axis lie along that axle. In the absence of the instrument, it may be drawn from the concentric ellipses, fig. 5 (Page 243), which may be placed under the paper, in the position above described, and seen through it, if the paper be not too thick; and in this method, the smaller concentric circles of the wheel may be described at the same time, as they may be seen through the paper, or if they should not be exactly of the right size, it would be easy to describe them by hand between the two nearest concentric ellipses; and thus, also, the height of the cogs of a wheel, in the different parts of it, may be exhibited longer and narrower towards the extremities of the minor axis. Their width may be determined from the divisions of the ellipse. In most cases, this may be done with sufficient accuracy, from the circumference of the ellipse being divided into eight equal divisions of the circle, by the two axes, and two isometrical diameters, each of which parts may be sub-divided by the skill of the artist; and not only the face of the wheel in front may be thus exhibited, but the parts of the back circles also, which are in sight, may be exhibited by pushing back the system of concentric ellipses on the minor axis or axle through a distance representing the breadth of the wheel, and then tracing both the exterior and the interior circles of the wheel, and of the bush on which it is fixed, as far as they are visible. Care should be taken to represent the top of the teeth, or cogs, by isometrical lines, parallel to the axle, in a face-wheel, or tending to a proper point in the axle in a bevil-wheel. And nearly in the same way, may the floats of a water-wheel be correctly represented. If a series of concentric ellipses, such as are given, fig. 5 (Page 243), be not at hand, it will still be easy for an artist to draw the ellipses with sufficient accuracy for most purposes, by drawing through the proper point in the axle, the major and minor axes, and the two isometrical diameters, thus making eight points in the circumference to guide him.

"If, in any case, it should become necessary to represent a circle, which does not lie in an isometrical plane, we may observe, that the major axis will be the same in whatever plane it lies: and it will be the picture of that diameter, which is the intersection of the circle, with the plane parallel to the picture, passing through its centre. And the major axis will bear to the minor axis the proportion of radius to the sine of the inclination of the line of sight to the plane of the circle. We may observe further, that the diameters of the ellipse, which are to the major axis, as $\sqrt{2}$ to $\sqrt{3}$, when such exist, are isometrical lines.*

"And the representation of every other line parallel, and equal to any diameter of the circle, may be exhibited by drawing it equal and parallel to the corresponding diameter in the ellipse. If it should be desired to divide the circumference of an ellipse into degrees, or any number of parts representing given divisions of the circle, it may be done by the following method:

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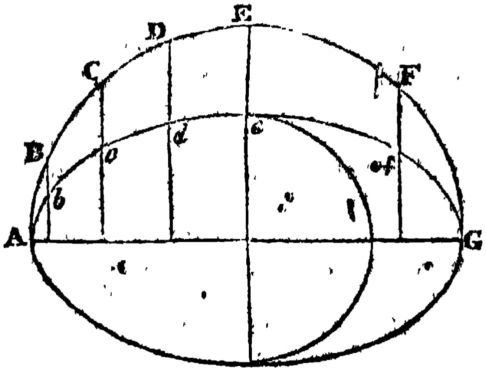
* We may remark, that if a cone be described, having its vertex at C, which lies in the line of sight, fig. 2 (Vide Frontisp.) and passing through the three radii C B, C E, C G, all the straight lines in the superficies of that cone passing through C, and all other lines parallel to any of them, are isometrical, as well as those parallel to the three principal isometrical lines, C B, C E, C G: and no other lines but these can be on the same scale. But though these multiply the number of isometrical lines infinitely, it is of little practical use, because it is only those which are parallel to the three principal lines, that can be easily distinguished at sight, to be isometrical.

We may further remark, that if a line be drawn through the point C, parallel to any given line whatever, and that line be made to revolve round the line of sight, at the same angular distance from it, so as to describe the surface of a cone, all other lines parallel to it, in any of its positions, will be isometrical, as they repeat one another.

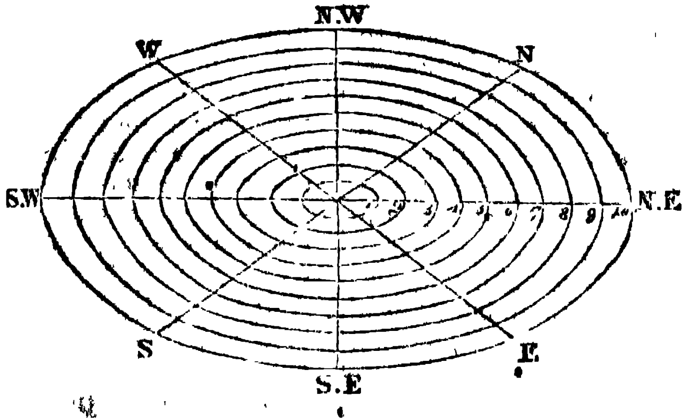
Fig. 6.



"Let an ellipse be drawn, figure 6, and on its major axis, A G, a circle described, with its circumference divided into degrees or parts in any desired proportion, at B, C, D, E, F, &c. from which points draw perpendiculars to the major axis. They will cut the periphery of the ellipse in corresponding points. It would be difficult, however, in this way, to mark, with sufficient accuracy, the degrees which lie near the extremities of the major axis. But the defect may be supplied, by transferring those degrees in a similar way, from a graduated circle described on the minor axis. In this manner, an isometrical ellipse may be formed into an isometrical circular instrument, or an isometrical compass, which may shew bearings, or measure angles on the picture, in the same manner as a real compass, or circular instrument, would do in nature.

"It may be often useful to have a scale to measure distances, not only in the isometrical directions, but in others also. And this may be done by a series of similar concentric ellipses, as in fig. 7.

Fig. 7.



"Dividing the isometrical diameters into equal portions. The other diameters will be so divided as to serve for a scale for all lines parallel to them respectively.

"Thus, in the isometrical squares, exhibited in figure 2 (Vide Frontispiece), distances measured on the longer diagonal, or its parallels, would be measured by the divisons on the major axis; those depending on the shorter diagonal, by the divisions on the minor axis.

"To describe a cylinder, lying in an isometrical direction, the circles at the extremities should be represented by the proper isometrical ellipses; and two lines touching both, should be drawn; and in a similar way, a cone, or frustrum of a cone, may be described. A globe is represented by a circle, whose radius is the semi-major axis of the ellipse, representing a great circle.

"It would not be difficult to devise rules for the representation of many other forms which might occur in objects to be represented. But the above cases are sufficient to include almost every thing which occurs in the representation of models, of machines, of philosophical instruments, and, indeed, of almost any regular production of art.

"Buildings may be exhibited by this perspective as correctly, in points of measurement; as by plans and elevations, under the advantage of having the full effect of a picture.

"A bridge, or any circular or gothic arch, consisting of portions of circles, lying in isometrical planes, may be represented by portions of isometrical ellipses, which will easily be adapted and drawn upon the principles already explained, by which wheels are exhibited on their axles. The centres of those circles must be found, with which the centres of the ellipses must be made to coincide; their minor axes lying along the lines drawn from those centres, perpendicular to the planes of the circles. The shaft of a pillar consists of a frustum of a cone and a cylinder united; or, perhaps, of a cylinder alone, or a congeries of cylinders: and we have already shewn the method of exhibiting these, as well as their bases. And on the same principles, the position and size of the volutes and ornaments of the capital may be found, and such guiding points as will make it easy to trace their forms. Thus, the different courts and edifices of a cathedral, a college, or a palace, may be correctly depicted; and even the rooms and internal structure, though less in the form of a picture, may be exhibited in such a way, as to enable an architect, or his employer, to contemplate their situation, their ornaments, furniture, or any other circumstance belonging to their appearance, and to mark down, exactly, what he would have done, in such a way, as could hardly be misunderstood, by an attentive agent, though at a distance.

"But in thus exhibiting buildings as transparent, and their interior laid open, there is a danger of being confused by a multiplicity of lines, which is a difficulty in a building containing many rooms, that would need some address to get over. It is better adapted to exhibit the inside of a single room; of a cathedral, for instance, the aisles and transepts of which would not cause any great perplexity.

"In the same manner, a plan of a city might be given, which would not only represent its streets and squares, as well (by the help of the scale above described, fig. 7,) as a common plan, but also, a picture of its churches and public buildings, and even its private houses, if such were the design contemplated by the artist, as they would almost all become visible when looked down upon from the commanding height which this perspective supposes. And such a single exhibition, if well executed, might give a better idea of a distant capital than a volume of description.

"In the instances which have been given, most of the lines are isometrical. But the art is applicable to many cases, where there are few, or none such. It may be necessary, in many of them, to draw isometrical lines, or isometrical ellipses, by way of a guide, to determine the position of certain lines and points, to enable the artist to describe with accuracy what he has in view. And there is scarce any form so anomalous, as to preclude the artist from taking advantage of these methods of ascertaining such lines or points in it as will give him much assistance in representing it with precision. If the intention be merely to make a picture, the guiding lines may be obliterated as soon as they have served the purpose designed, or they may be retained in some cases, and their lengths or diameters noted down in figures, if it be wished, to give ready information. And often, if the artist wishes to provide materials to enable him, at his leisure, to give accurate descriptions or exact drawings, the rudest exhibition of such lines may completely serve his purpose, provided he notes down on the spot such measurements with accuracy, however unexact the lines may be on which they are recorded. In many cases, it may be expedient to take liberties with this perspective, or with the picture, which will make it suit the purpose designed. And this will produce no confusion, provided those liberties are explained: for instance, it may often be expedient to make the scale in the vertical direction larger, sometimes very considerably so, than in the horizontal. It may, in some cases, be necessary, to represent on paper what is hid in nature. What has been said on the internal structure of buildings, is an instance of this, as well as what we shall observe on the exhibition of subterraneous objects. We shall proceed to give some examples of these observations.

"To give such a representation of an Etruscan vase as would enable an artist to model it exactly, would be exceedingly easy. Let a vertical line be drawn to represent the axis of the vase, fig. 8 (Vide, Frontispiece), and let points be taken in that axis, corresponding to the centres of the principal circles of the vase; through which, the horizontal isometrical lines may be drawn, representing the radii of those circles, by the help of which, the isometrical ellipses representing them are easily drawn. These will become a complete guide to the artist. He may assist himself by looking at the object along the line of sight, and then, if he has any skill in drawing, he will find no difficulty in tracing the outline from one of these to the other, with sufficient correctness. If he is unskilled in the art, of course, he must be at the trouble of finding a larger number of ellipses to guide him. And in a similar manner, any solid, formed by the revolution of a plane figure round one of its sides, may be represented."

(To be concluded in our next.)

LONDON MECHANICS' INSTITUTION.

MR. GOWRING'S LECTURE ON MAGNETISM.

PROPERTIES OF THE MAGNET—ITS POLARITY, OR DIRECTIVE POWER—COMMUNICATION OF MAGNETIC POWER—ARMATURE OF THE MAGNET—ITS ATTRACTION—VARIATION OF THE MAGNETIC NEEDLE—DIPPING NEEDLE—EXPERIMENTS ON SOFT IRON—CONNECTION BETWEEN MAGNETISM AND ELECTRICITY—AMUSING MAGNETIC EXPERIMENTS—CONCLUSION.

WEDNESDAY, JANUARY 25TH.

MR. GOWRING introduced the important and intricate subject of the present evening's lecture, by observing, that the magnet is said to have derived its name from a shepherd of Mount Ida, named *Magnes*, who first discovered it by means of the iron at the bottom of his crook. By others, it has been derived from *Magnesia*, a town or district of Thessaly. The magnet has also been called *lapis heraclæus*, from *Heraclea*, a city of Magnesia; and the name of *siderites* has been given to it, from *sideros*, the Greek word for iron. Perhaps, the appellation of *load-stone*, arose from its property of bearing a load.

The *magnet*, or *load-stone*, contains a greater proportion of *iron* than any other iron ore, and is mixed with *silex*, *alumina*, and *sulphur*. Its specific gravity is about 7, and it generally appears of a brownish black colour; but there are different species of it, which are found in different countries; one specimen exhibited by the Lecturer came from Arabia, and was of a reddish colour. The characteristics of *magnets*, both *natural* and *artificial*, are the same, and may be stated as follows:—

1. Magnets *attract iron* in its metallic state.

2. They possess a *directive power*, or *magnetic polarity*, which acts *horizontally*.

3. The opposite poles of magnets *attract* each other, but similar poles *repel each other*.

4. Magnets have a *vertical* motion, which is called *dipping*.

5. They are capable of *imparting* their power to *iron* or *steel*; to both, when hardened, *permanently*.

Of these properties, only the first and third were known to the ancients. With respect to the *directive power*, or *polarity* of the natural magnet, it may be observed, that, magnets have sometimes more than two poles, owing to their heterogeneous nature and irregular figure; and the situation of the additional poles can be ascertained only by trial. When this is the case, the parts adjacent to a pole possess the contrary polarity, and the North and South poles are either *equal* in number, or differ by *one only*. Thus, there may be 4 South and 4 North poles, or 3 or 5 North to 4 South poles, &c. Magnets of the closest grain have the greatest power, and their attraction is strongest at the poles and in contact. In imparting the magnetic power to iron and steel, it is found that these substances, when *soft*, take the power more easily, but do not retain it so tenaciously as when *hard*.

Smaller pieces of the *natural magnet* are stronger, in proportion to their size, than larger ones, and a piece cut from a large magnet will sometimes possess greater power than the magnet from which it has been separated, owing to the power being stronger in one part than in another. Sir Isaac Newton had a magnet, weighing only 3 grains, which he wore in his ring, and which was capable of lifting 746 grains, or nearly 250 times its own weight.

Mr. Gowring then proceeded to illustrate the various properties of the magnet, by a variety of interesting experiments. He first exemplified the method of *communicating* the magnetic power, by rubbing a piece of steel with a natural magnet, which he effected by touching it at one extremity with the *North* pole of the magnet, which he drew along the piece of steel to the other end; repeating this motion several times, and taking care not to pass the magnet in the contrary direction, which he observed would destroy the effect produced.

The piece of steel thus magnetised possessed all the properties of the natural magnet, as its poles attracted or repelled the contrary or similar poles of another magnet; the extremity which was first touched by the *North* pole of the natural magnet possessing *North* polarity, and the opposite end *South* polarity. It was also proved to be capable of communicating the magnetic power it had acquired.

The poles of a natural magnet were then shewn, by covering one with a piece of writing-paper, upon which steel filings were strewed; for the particles of steel immediately arranged themselves according to the force of attraction exerted upon them, and were collected in the greatest quantity at the poles of the magnet. A similar effect took place when steel filings were exposed to the attraction of the magnet, without the intervention of the paper; the greatest number of particles being taken up at the poles.

The power of the natural magnet may be greatly increased by what is called the *armature*, which consists in attaching a piece of soft iron to each side of the magnet in the direction of its poles, in which case, it is capable of lifting a much greater weight than without the *armature*.

The earth itself is a natural magnet, and is capable of communicating the magnetic power to bars of iron, without the agency of either the natural or artificial magnet. A bar of hard iron (a poker for instance) acquires magnetic properties by remaining for a length of time in a position nearly perpendicular. Mr. Gowring here presented the extremities of a poker to the poles of a suspended needle, and its effect, in attracting or repelling them, as dissimilar or similar poles were presented, proved that the poker possessed magnetic properties. Any person, with sufficient patience, may communicate magnetism to an unmagnetised bar of steel, by laying it on a large bar of iron, in an inclined position, and rubbing it upwards with a bar of steel, without taking a back stroke, which will destroy the effect of the operation. After passing the steel bar along the other bar of steel about 150 times, the latter will acquire magnetic power, and be capable of communicating it, though, in the first instance, neither a natural nor artificial magnet was used. Workmen's files generally acquire this power by the position in which they are placed, and there is scarcely one in a hundred that is not an artificial magnet.

Mr. Gowring then magnetised two bars of steel, placed end to end, by passing a magnet two or three times along them both, in the same direction, when they immediately adhered together by the attraction of their contrary poles; but, upon passing the magnet along them only once in the opposite direction, their magnetic attraction was destroyed, and they instantly separated.

Some other methods of communicating the magnetic power, by disposing the bars in different directions, were then exhibited, after which, Mr. Gowring observed, that the *attractive power* of the magnet appears to have been discovered by Flavio de Gioia, a Neapolitan, who lived in the 13th century, though it was alluded to at an earlier period by Guyot de Provins, an old French poet.

With respect to the *directive power*, or *polarity* of the magnet, it should be observed, that it does not point exactly to the *North*, but, at the present time, about 24°, 37′ to the *Westward* of the North. This variation was first observed by Columbus, in the year 1492, at which time it was to the *Eastward* of the North; but the deviation gradually diminished, till the year 1657, when the magnet pointed *due North* and *South*. From that period the variation increased in the contrary direction, till about two years ago, when it reached 24°, 37′ *Westward* of the North; since which it has been slowly returning *Eastward*, and now amounts, as before stated, to 24°, 35′ *Westward* of the North.

The next remarkable property of the

magnet is its *vertical* motion, or *dip;* for when a magnet is freely suspended, it does not preserve its *horizontal* position, but declines or *dips* towards the earth. A *dipping needle*, when accurately constructed, which is a matter of considerable difficulty and expense, should *dip* about 70 degrees in this latitude. It has been stated that the earth is a natural magnet, and as the earth has its equator and poles, so has every magnet. At the *magnetic equator* the magnet has no dip, but this equator has not been exactly ascertained, because the poles of the earth do not correspond with the magnetic poles. Mr. Gowring here illustrated his remark, that every magnet has its poles and its equator, by passing a *dipping-needle* along a powerful magnet, from one extremity to the other. At one end of the magnet, the *North* pole of the needle *dipped* about 70°, but this inclination decreased as it approached the centre of the magnet, when it remained in a *horizontal* direction. As the needle proceeded towards the opposite end of the magnet, its *South* pole became depressed in an equal ratio; and, upon passing it back again, the same phenomena occurred in the contrary direction. The Lecturer proceeded to observe that, in the construction of the mariner's compass, the equilibrium of the needle is preserved by either making the North end lighter than the South, or by attaching a sliding piece to the latter, by which the needle can be adapted to different latitudes. He also adverted to Pope's dipping needle mariner's compass (of which we gave an ample description in our Second Volume, page 2), and expressed his apprehension that it would not answer in all latitudes. The *dipping needle* was first discovered by Robert Norman, a compass maker: the *dip* is is generally said now to be 71°, 50′; but Mr. Barlow considers it to be about 70°.*

It is a singular property of the magnet, that its power, instead of being deteriorated, is rather increased by communicating it; and in this respect, it bears a striking resemblance to the human mind, which loses none of its powers by imparting its stores of knowledge to others, but, on the contrary, finds, that the more its resources are used for the benefit of others, the more ample they become. This just and apposite comparison was received with loud applause by the audience.

It is also remarkable, that when a magnet is broken, each piece becomes a perfect magnet. Mr. Gowring exemplified this remark by first magnetising a piece of steel, and then breaking it; after which he shewed, that each of the pieces exhibited all the properties they possessed when united.

Having observed, that *permanent magnetism* cannot be communicated to *soft iron*, Mr. Gowring illustrated the observation by presenting a bar of *soft iron* to the poles of a magnet, both of which it *attracted;* thus proving, that it did not possess magnetic power. But the moment a magnet was placed at the end of the bar, it exhibited magnetic properties by *repelling* one pole and *attracting* the other. This effect ceased upon removing the magnet, whereas, a bar of steel, under similar circumstances, would have remained *permanently* magnetic. Several balls of soft iron were then suspended to the end of a magnet, one below another, and while the first was in contact with the magnet, they remained attached together; but on taking this away, the rest immediately fell asunder, as they possessed no power over each other. On the same principle, two teetotums were spun upon the table, and successively taken up by a magnet, to which they hung, point to point, and both kept spinning in the air in a very curious manner, but separated the moment the upper one was removed from the magnet.

Mr. Gowring next proceeded to shew the connection between *electricity* and *magnetism*, by communicating the magnetic power to pieces of steel, by the shock of an electrical battery. This subject has been already illustrated in Mr. Lewthwaite's lecture (Vide vol. II., page 115), and we, therefore, need only add, that Mr. Gowring placed a piece of steel within a *helix*, or a wire coiled into a cylindrical form, but the direction in which the wire was turned was twice changed in the length of the cylinder, so that the inclination of the wire was partly to the *right* and partly to the *left*. The effect of this arrangement was, that when the shock of the battery was passed through the *helix*, the needle had four poles, instead of two; the change in the direction of the coils of the *helix* having occasioned the communication of *contrary polarities* to the three portions of the needle.

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* In our Second Voulume, page 342, our readers will find a very interesting account of the original discovery of the dipping needle, extracted from a scarce and curious pamphlet, written by Robert Norman, entitled "The Newe Attractive," published in 1580.

The Lecturer then observed, that magnetism is conveyed through almost any substance except *iron*, and he proved by experiment, that it is communicated through paper, wood, and glass. He next adverted to the fact, that the large quantity of *iron* contained in a ship, has a material effect on the compass, and described the experiments made by Mr. Barlow, to discover the method of counteracting this attraction. Mr. Barlow discovered, that every mass of iron has a plane of no attraction, which is the complement of the dip, and also, that the attraction of iron for the magnet is analogous to the laws of electricity; its attraction being in proportion, not to its *mass*, but to its *surface*. A *shell* will, therefore, attract as powerfully as a *shot* of the same size. By a variety of ingenious experiments conducted on these principles, Mr. Barlow succeeded in constructing an apparatus, by which the effect of a ship's iron on the compass is completely obviated.

Mr. Gowring then stated, that he should conclude his lecture by a few amusing experiments, which, to some, might appear trifling; but he was of opinion, that in delivering public lectures to operative artificers, no experiments could be deemed unimportant, which might enable them to comprehend philosophical facts, or turn their attention to such inventions. A vessel of water was then exhibited, in which a fish appeared to be swimming, but upon presenting a magnet towards it, the fish was caught, and drawn out of the water. Two swans were then placed on the surface of the water, and followed, or receded from, a magnet which was held towards them.

An apparatus called the *divining circle*, was next exhibited, consisting of two circles, one containing questions, the other answers; and the apparatus was so contrived, that the proper answer to each question was pointed out by a needle, from the operation of a concealed magnet. A German toy, still more ingeniously constructed, but acting upon a similar principle, was next exhibited; and, finally, a little apparatus, somewhat resembling a pigeon-house, which the Lecturer was the first to introduce to the public, and which was invented by a gentleman in the silk trade. Six tablets were produced, in the middle of each of which, the picture of a card was placed. A gentleman having selected one of these tablets, it was placed in a box and put under the bottom of the pigeon-house, when a small door in the upper part immediately flew open, and exhibited a miniature representation of the five of hearts; which was the same card that was painted on the tablet.

The same effect was produced upon introducing the tablet on which was painted the ten of spades, for the door, on flying open, exhibited this card in miniature. The Lecturer then explained the manner in which the operation was performed, by shewing, that a magnet was concealed in each of the tablets, and the six different cards being painted on a moveable cylinder in the pigeon-house, the power of the magnet on a needle fixed to the spindle, round which the cylinder revolved, infallibly brought the corresponding card opposite to the small door, which was at the same moment thrown open by a spring.

Mr. Gowring concluded by observing, that he had now been about two years a Member of the Institution, during which period, he had watched its progress with considerable interest. He had been informed that, by the delivery of his brief course, he had become doubly a Member, and he took leave of his audience with the most sincere wishes for their continued prosperity.—The worthy Lecturer then withdrew amidst the acclamations of his numerous auditors.

Mr. M'WILLIAM then gave notice, that Mr. PRESTON, a Member of the Committee, had kindly offered his services, to instruct a Class of about 50 pupils, in ENGLISH GRAMMAR, and it was therefore requested, that those Members who were desirous of receiving this Instruction, would transmit their names and addresses to the Secretary. In forming this class, the preference would be given to those applicants who were not pupils in any of the other Elementary Schools.

MR. TATUM'S
FIRST LECTURE ON ÆROSTATION.

INTRODUCTORY REMARKS — HISTORICAL SKETCH OF ÆROSTATION — INVENTION OF MONTGOLFIER BALLOONS IN FRANCE—BALLOONS INTRODUCED INTO ENGLAND—THEIR INFLATION WITH HYDROGEN GAS—WITH CARBURETTED HYDROGEN — EXPERIMENTS — METHODS OF GENERATING HYDROGEN—

ASCENT OF A BALLOON FILLED WITH RAREFIED AIR, &c.

FRIDAY, 27TH JANUARY.

Mr. Tatum commenced his lecture by observing, that amongst the various branches of useful knowledge communicated by the Institution, there were schools for the instruction of the Members in the Mathematics and Arithmetic; but it must be evident, that it would be useless for any person to attempt the acquisition of the former, without being previously well grounded in the latter. So it is with science, the various branches of which are mutually dependent on each other; and it was upon this principle, that he commenced his course with the subject of AEROSTATION; to understand which, a previous acquaintance with some other sciences was indispensably necessary. Before the principles of *Aerostation* could be properly comprehended, a knowledge of *Pneumatics* was requisite; and he had a right to presume, from the lectures which had been delivered on that subject, that the Members were acquainted with the nature and properties of *air*. A knowledge of *hydrostatics* is also essential to the study of a science which treats of bodies floating in a certain medium, by displacing a quantity of the fluid in which they float, equal in weight to the floating body. Besides this, it is necessary to know, that *air* is a *gravitating medium*, and, therefore, not only *Pneumatics*, but *Hydrostatics*, must be understood; so far, at least, as relates to the *specific gravities* of bodies. *Chemistry* also is necessary, in order to a right understanding of the preparation of gases for balloons; whether by the rarefaction of common air, by *carburetted hydrogen*, or otherwise. Another property of *air*, besides its *gravitation*, is necessary to be known, viz. its *elasticity;* because the atmosphere is not of uniform density, but is much more rare in the upper than in the lower regions. Thus, a balloon filled with air equal in density to the atmosphere at the surface of the earth, would burst (if perfectly air-tight) in the upper regions, by its *elasticity*, or tendency to expand, when the exterior pressure is diminished. But the aeronaut, being aware of this fact, is enabled to provide a remedy for it, and to avoid consequences which might otherwise prove fatal to him. Another property of air necessary to be known is, its *resisting power;* for the *parachute*, which is an almost indispensable accompaniment to a balloon, depends on the *resisting* property of the atmosphere: in a vacuum, it would fall like a stone, which the Members had, no doubt, seen illustrated in the guinea and feather experiment. Mr. Tatum hoped to be able to shew the possibility of giving a directive power to balloons, or of conducting them *horizontally;* and with these preliminary remarks, he should proceed to give a concise historical account of Aerostation.

There is no doubt that the idea of conveying themselves through the atmosphere, occurred to the minds of men at a very remote date. It is almost impossible for any person to witness the manner in which birds transport themselves through the air, without wishing to possess the same power. This desire must be strengthened by the numerous impediments which present themselves in travelling over land; for even where there are no turnpikes in the way, the progress of the traveller is impeded by mountains, bogs, rivers, arms of the sea, thick woods, and other obstacles, none of which are encountered by the winged part of the creation. Man, therefore, at a very early period, conceived the idea of attaching *wings* to his body, and wafting himself through the air by their agency; but when we compare the anatomical structure of man with that of birds, it must be obvious that all attempts of this kind must be unsuccessful; and accordingly we find, that though many have tried the experiment, none have ever succeeded in raising themselves more than two feet from the ground. Some, indeed, have contrived to fly *downwards*, but even in this case, have sustained severe injuries.

Our neighbours, the French, from observing that *smoke* rose from chimneys, thought that if a flaccid body, a bag for instance, was filled with smoke, it would ascend as the smoke did. But this idea was erroneous; for *smoke*, of itself, will not ascend, and it rises only in consequence of being heated, and driven up by a current of colder air. Nor does it ascend, owing to the production of gas; for no gas produced by combustion, is specifically lighter than the atmosphere. The products of the combustion of *alcohol*, for example, are *water* and *carbonic acid gas*, both of which are much heavier than air. Balloons of this kind, then, ascend merely in consequence of the interior air being *rarefied*, or *expanded*, by the *heat* produced during the combustion, and not by the agency of any smoke or gas, generated by the combustible materials.

A balloon of this description was constructed, on a very extensive scale, by Montgolfier, and was capable of lifting 7 cwt. Some living animals were afterwards sent up, which floated in the atmosphere, till the condensation of the rarefied air rendered the balloon and its load specifically heavier than the external air, when it descended in perfect safety. The success of this experiment encouraged persons to ascend in a similar manner, and the Lecturer believed that Pilatre de Rosier, whose life was afterwards unfortunately sacrificed in an aerostatic excursion, was the first who ventured to make the attempt. Soon after this period, balloons became somewhat common in England, and the first that ascended in this country was sent up from the Artillery Ground, in the year 1783: this balloon took a southerly direction, and descended upwards of 40 miles from London. This was followed by the ascent of Lunardi from the same place; and Blanchard subsequently ascended from a confined spot near Barbican, as well as from other places.

The experiments of Mr. Cavendish, who first obtained *hydrogen gas* in a pure state, gave rise to the application of this gas to the inflation of balloons. It occurred to Dr. Black, that if a light, flexible substance were filled with *hydrogen* it would ascend in the air; and he used the membrane of a calf, as the finest substance he could procure for that purpose. Dr. Black, however, failed in his attempt, and then had recourse to *soap-bubbles*, which he blew up with *hydrogen gas*, and found that they ascended with considerable velocity; whereas, when filled with common air, they will not ascend, because the film of soap, and the air it incloses, are together specifically heavier than the air itself.

There was a period, continued the Lecturer (and perhaps that period is hardly passed), when a mania existed for the establishment of Companies; and at the time to which I allude, which is now some years since, a friend of mine proposed to establish a Company for travelling through the air, and printed a syllabus of his plan. And what do you supppose his plan was? Why, to take us up at our own doors in London, and set us down at our country-houses, by means of balloons! *(Laughter.)* And notwithstanding all the arguments I could use, I was unable to convince him of the impracticability of his project. This person had a sailing vessel, and he argued that, if he could direct the motions of this vessel, why should he not be able to guide a balloon in the same manner? I told him that, in the former case, the vessel moved in two different media, the hull being in one, and the sails in another; and that, before he could direct his balloon, he must prove that the wind passed it, as it passed the sails of a vessel. I then enquired, how he meanto take up and set down his passengers? And this, it appeared, was to be accomplished by lowering and elevating an elegant chair, by means of a windlass. *(Laughter.)* When I was last at his house, he produced a 5*l.* note, which was all that remained of 50*l.*; the remainder having been expended in advertisements, to bring his company to bear. Thus it appears, that some men, though intelligent on many subjects, on others exhibit a kind of insanity.

Another gentleman, who is still living, and possesses considerable skill in mechanics, proposed to construct balloon which should start from the place where it was made, and after going round London, should return to the spot from which it started. The motive power, in this case, was to be the *steam engine*, and the prejector employed a number of ingenious mechanics, for some years, for the accomplishment of his design. Now, if steam engines could be made of *tissue paper*, there might be some chance of carrying this plan into effect; but when the great weight of steam engines is considered, it must be evident that their agency cannot be employed, in directing the motions of aerostatic machines.

Balloons were next inflated with *carburetted hydrogen gas*, by Mr. Green, who was the first aeronaut that ascended with a balloon filled with this gas. Mr. Tatum here eulogized the construction of Mr. Green's balloon, the seams of which were cemented together in such a manner, that the silk gave way sooner in any other part than where it was joined. The Lecturer would have had no hesitation in ascending with him, without any other security to the seams, but Mr. Green was over-persuaded to take the additional precaution of having them stitched. When he first proposed ascending with a balloon filled with *carburetted hydrogen*, many philosophical men pronounced the thing impossible, from an idea that the gas was specifically heavier than it really is; but that Mr. Green actually did ascend by this means, most of the Members, perhaps, had an opportunity of witnessing.

Mr. Tatum having thus concluded his historical sketch, proceeded to an experimental illustration of his subject. The first experiment exhibited a cylindrical vessel of water, containing a small glass balloon, which descended, remained stationary, or ascended, according to the pressure of the Lecturer's hand on the cover of the vessel, on the principle of the "*Cartesian Devils*," described in Mr. Gowring's lecture (page 214). This experiment was varied by means of another vessel, open at the top, and containing a similar balloon, which remained at the bottom of the vessel, owing to its specific gravity being greater than that of the water in which it was immersed. Some hot water was then poured in, and the heat thus communicated, rarefying the small quantity of air contained in the balloon, forced out a portion of the water, and thus rendered it specifically lighter than the surrounding fluid, in consequence of which, it rose to the surface. Upon pouring in cold water, the air in the balloon was condensed, the water was re-admitted, and its increased specific gravity caused it again to descend.

Some other experiments were then performed, illustrative of the fact, that bodies will ascend, when surrounded by a fluid of greater specific gravity than themselves; and also demonstrating the *elasticity* of the air. The Lecturer then adverted to the suggestion of Francis Lana, an ancient writer, who proposed to exhaust the air from hollow vessels of thin copper, and, on that means, cause them to ascend. But, though the theoretical reasoning of this author was correct, the method he proposed was inadequate to the intended effect; for as the Members are aware, that the atmosphere presses with a weight of 15lbs. upon every square inch, they must be sensible, that if a hollow ball of copper was made sufficiently thin to rise in the atmosphere, when exhausted of air, it would be crushed together by the external pressure, and if, on the contrary, it was made thick enough to resist the pressure of the atmosphere, it would be to heavy to ascend in it.

In order to fill a balloon with *hydrogen gas*, two methods may be adopted; one of which is, to effect the decomposition of water by means of *sulphuric acid* and *zinc*; and the other, by passing the steam of hot water through a heated iron tube; the *oxygen* of the water, in both cases, uniting with the metal while the *hydrogen* is set at liberty, and passes into the balloon. To shew that the *hydrogen* is produced at the expense of the *water*, the Lecturer placed some *granulated zinc* in a glass retort, and poured upon it some highly concentrated *sulphuric acid*. The neck of the retort was placed in communication with the pneumatic trough, but no *hydrogen* was evolved till *water* was poured into the retort, when the gas was immediately generated, and rose in the vessel in numerous bubbles.

Mr. Tatum then proceeded to fill a balloon, a few inches in diameter, with *hydrogen gas*, generated as in the preceding experiment, by the mutual action of *sulphuric acid*, *water*, and *zinc*. The apparatus used for this purpose, was very ingeniously contrived, the tube through which the acid was poured being bent upwards like a syphon, in the middle, and then bent downwards. By this arrangement, the bend of the tube remained filled with the acid, which could be supplied at the upper orifice without opening the apparatus, and without the possibility of any of the gas escaping during the operation. The small balloon was soon inflated, and would have ascended to the ceiling, if it had not been purposely confined by a string. It, however, remained for some time suspended a short distance above the lecture-table, when it became specifically heavier than the atmosphere, and, consequently descended. The Lecturer then attempted to shew that, though the balloon would not float in *common air*, it would be supported in a denser medium; and he, therefore, endeavoured to introduce it into a vessel filled with *carbonic acid gas*; but the vessel was not quite large enough to admit the balloon without coming in contact with its sides, and the experiment, consequently, failed; though, under other circumstances, there could have been no doubt of its success.

Mr. Tatum then exemplified the experiment of Dr. Priestley, by inflating some *soap-bubbles* with *hydrogen*, and proved the inflammable nature of the gas by applying a light to some of the bubbles as they ascended, when they instantly burst into a flame. He also observed, that when small balloons are made to ascend by rarefying the air they contain, a lighted body (for instance, a piece of sponge dipped in spirits of wine), is generally attached to them; this, however, is not necessary to cause their ascent. A paper balloon nearly 4 feet in diameter, was now held up by the assistant, while the Lecturer applied the flame of a sheet of brown paper to the large orifice at the bottom; the heat of the flame soon rarefied the small quantity of air in the balloon, till it became fully inflated, and, upon being liberated, it rose to the roof of the theatre; where it floated for a short time, and then descended into the pit, and was passed to the lecture-table by the Members.

Mr. Tatum concluded by observing, that, as he could not complete his remarks on Aerostation in one lecture, he should continue the subject, on Friday next, when he should fill some balloons of greater magnitude, and also explain the mode of ascertaining the cubic contents of balloons, which it was necessary to know before their *ascending power* could be calculated.

MR. M'WILLIAM then reminded the Members that the time was near at hand, when they would be called upon, according to the rules and orders of the Institution, to elect a President, 4 Vice-Presidents, a Treasurer, and 15 Committee men. He therefore requested the Members to transmit to the Committee, as soon as possible, their nominations of persons properly qualified to fill the above offices.

LECTURES FOR NEXT WEEK.

Wednesday, February the 8th, Mr. FREND's First Lecture on Geography.

Friday, February the 10th, Mr. TATUM's Lecture on Optics.

MECHANICS' INSTITUTIONS, AND TOM PAINE'S WORKS.

OUR readers will, we have no doubt, consider the title of the present article as exhibiting a most extraordinary and unnatural association of ideas, and they will very naturally enquire what possible connection can exist between the two subjects therein specified. We really cannot tell them; for we should as soon have thought of identifying honesty with thieving, or Jaggernaut with the Deity, as of mentioning MECHANICS' INSTITUTIONS and Tom Paine in the same breath.

It appears, however, by the public journals, that the anniversary of this man's birth was celebrated, a few days since, by a dinner at the Crown and Anchor tavern, upon which occasion the chair was taken by Carlile, and the principal spouter was the *Reverend* Robert Taylor, Secretary (at a salary of 200*l.* per annum) and orator-general to the mis-named "Christian Evidence Society." In the course of the proceedings (as reported in the Newspapers), a Mr. Henman, in proposing as a toast, "Success to Mechanics' Institutions," had the effrontery to attribute their establishment, within the last two years, to the dissemination of Tom Paine's writings!!! We believe there is not an individual who is really acquainted with the origin of these excellent institutions, who is not able to give the lie direct to this impudent assertion. We should not have noticed this contemptible assembly, if its proceedings had not been unnecessarily and injudiciously blazoned forth in the papers; but as this has been done, we would ask whether there is a jot of evidence, either christian or unchristian, that the diffusion of Tom Paine's works has been connected, in the most remote manner, with the anxiety for *scientific* instruction, which has led to the establishment of Mechanics' Institutions? Is it to the strenuous exertions of many of the most distinguished ministers of the Church of England, in promoting the objects of these Insitutions in different parts of the country, that we are to look for this evidence? Or are we to infer it from the result of the application made, not long since, to the Committee of the London Mechanics' Institution, by the '*Reverend* Robert Taylor, to engage their Theatre for the use of the "Christian Evidence Society?" an application which, without a moment's hesitation, without a moment's discussion, was rejected with contempt, and even with disgust.

Convinced as we are of the important benefits that have already resulted from the establishment of Mechanics' Institutions, and the still more important advantages which they will ultimately produce to society, we have cautiously avoided any notice of the futile attacks that have been made upon them by certain literary purveyors, whom we should lift into unmerited importance by honouring them with a reply. From direct attacks of this kind, the friends of Mechanics' Institutions have nothing to fear, because both theory and practice have proved their arguments unanswerable. But when a number of individuals, associated for the purposes of blasphemy and sedition, presume to identify themselves with the promoters of such Institutions, it is time to apply an antidote to the poison they are attempting to infuse. The Poet says,

> " An open foe may prove a curse,
> " But a pretended friend is worse ;"

and from the mischievous support of *such* friends as these, Heaven deliver MECHANICS' INSTITUTIONS! We cannot conclude, without expressing our regret, that any of the respectable journals should have devoted their columns to an account of the dinner alluded to. Notoriety is the principal object of the speakers upon such occasions, and they would soon be sick of speech-making, if their illiterate rhapsodies were not bruited to the public in the newspapers.

SULPHUR IN THE ATMOSPHERE DURING THUNDER.

To the Editor of the Mechanics' Register.

SIR,—I will feel obliged to any of your Correspondents, who will explain to me in what way *sulphur* is supposed to be generated, or why it is found to exist in the atmosphere during thunder; as its presence at such time is very apparent, from the strong smell it emits, and the brassy appearance of the clouds. It has also been detected in the *rain water*, that falls during a thunder storm; but I never before heard of its being perceptible in such quantities, as appears by the following extract of a letter from the Rev. Mr. Gemmell, dated at Sharon Place, Upper Canada, 26th October, 1825 (taken from a Scotch paper), which says—" We had a thunder storm, about the middle of June, which, in some places not very distant from us, broke over, or tore up from the roots whole acres of trees: in our immediate neighbourhood it was not so severe. The lightning was very frequent and vivid, and the thunder correspondent and loud. What was very remarkable at this time, was the vast quantity of *sulphur* which fell with the rain; it was visible in every dish of water or tub, standing without, in which there was any water; and also on the ground. The clouds flying over our heads were yellow with the *sulphureous matter*, and the smell very strong. It was one of the warmest days I had ever seen. In the forenoon, the thermometer rose in the shade to 110 degrees."

I remain, Sir,
Your obedient servant,
Leigh Street. G. H.

P. S. A small quantity of *potash* is also said to be observable in *snow water*.—Query: From what cause?

DEPOSITION OF MOISTURE IN EXHAUSTED RECEIVERS.

To the Editor of the Mechanics' Register.

SIR,—Observing in your Register an enquiry, addressed to Mr. Gowring, by one of his hearers, on the subject of the clouded appearance of a receiver, during the process of exhausting it of atmospheric air, it occurred to me that the vapour which attaches itself to the receiver, is produced by the sudden abstraction of the *caloric*, which has the effect of converting the moisture remaining in the vessel, in conjunction with the rarefied air, into a kind of *hoar-frost*; which is afterwards deposited, though invisibly, upon the pump-plate. X. Y.

TO CORRESPONDENTS.

WE have not yet had time to translate the Letter transmitted by our French Correspondent, TACITANUS, but it will be attended to as soon as possible.

INQUIRENDO is informed, that communications for the Mechanics' Register must be sent to the Editor, at Messrs. Gifford & Co.'s, 62, Paternoster Row, *and no where else*. We are at a loss to conceive by what perversity of judgment INQUIRENDO can have supposed, that the proper way of transmitting letters to one Editor, is to put them into another Editor's box.

CLIO's Queries will be inserted; his First Letter did not reach us.

Communications have been received from D. D. D.—I. S.---J. W., Brighton----W. M.---R. J.---T. H——H.---A Constant Reader---A Member of the L. M. I.---&c. several of which are unavoidably postponed for want of

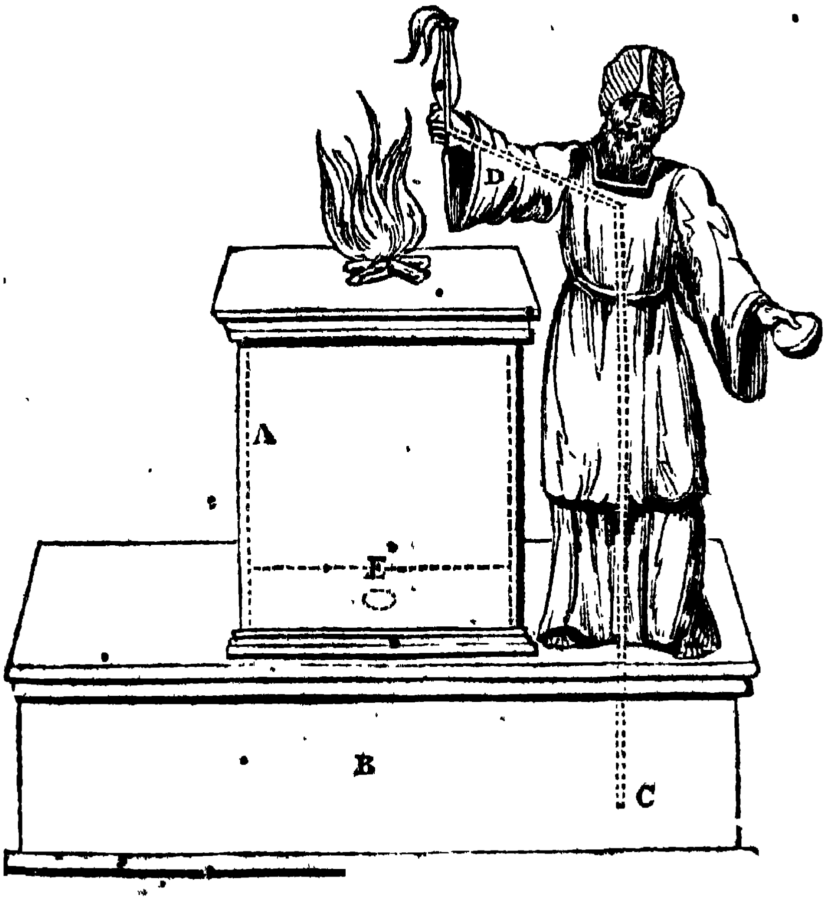
THE LONDON MECHANICS' REGISTER.

"Knowledge of books in recluse men, is like that sort of lantern, which hides him who carries it, and serves only to pass through secret and gloomy paths of his own; but in the possession of a man of business, it is as a torch in the hand of one who is willing and able to shew those who are bewildered, the way which leads to prosperity and welfare."

SPECTATOR.

No. 73.] SATURDAY, FEBRUARY 11, 1826. [Price 3d.

HERO'S ALTAR.



HERO'S ALTAR.

THE great expansive force of steam was known at a very early period, and the engine contrived by Hero, of Alexandria, may be considered as a sufficient illustration of this fact (vide Vol. II. page 324). The *elastic* power of air was also generally understood, and our frontispiece, this week, furnishes a picturesque view of the application of this knowledge, to aid the purpose of idolatrous superstition, described by the same philosopher, who was one of the builders of the church (now the mosque) of Saint Sophia.

The altar, *A*, is supported by the base, *B*, a communication being made by the dotted aperture, *E*. The lower vessel being filled with any *inflammable* fluid (*alcohol*, for instance), the application of a few half-extinguished embers to the top of the altar will expand the air contained within it, which, pressing on the surface of the fluid, must cause it to ascend the tube, *C*. The vase supported by the priest, at *D*, will then overflow, and the fuel will appear to blaze by super-human aid.

This description is extracted from a curious account of Hero's scientific labours, published in Greek, with a Latin translation. Paris, 1693, Folio.—(*Scientific Gazette.*)

LONDON MECHANICS' INSTITUTION.

MR. TATUM'S
SECOND LECTURE ON AEROSTATION.

MODE OF FINDING THE CUBIC CONTENTS OF A BALLOON—EXPENSE OF CONSTRUCTING ONE—SCIENTIFIC OBJECTS OF AEROSTATION—GREEN'S BALLOON—GARNERIN'S AERIAL VOYAGES—HYDROGEN GENERATED BY THE AGENCY OF IRON AND ZINC—PARACHUTES—MODE OF DIRECTING THEIR DESCENT—ASCENT OF A BALLOON IN THE FORM OF A WILD BOAR — MONTGOLFIER BALLOON—SUGGESTIONS FOR DIRECTING THE COURSE OF BALLOONS, &c.

FRIDAY, FEBRUARY 3.

AFTER briefly recapitulating the principal points adverted to in his former lecture, Mr. Tatum proceeded to explain the mode of ascertaining the cubic contents of a balloon, which is effected by multiplying the cube of its diameter by the decimal fraction .5236. Thus, if a balloon be 31 feet in diameter, the cube of this number, viz. 29791, being multiplied by .5236, will give 15598.5676 as the cubic contents of a balloon of that magnitude. (This calculation was exhibited at full length on the large diagram board.) Now, when the cubic contents of a balloon are found, it is not difficult to ascertain its *ascending power*; because we can readily find the weight of *atmospheric air* required to fill it, and also the weight of the same quantity of *hydrogen gas*, and the difference between these two weights will be the ascending power of the machine. But it should be considered, that the *hydrogen* used for inflating balloons is not procured in a pure state, particularly when it is obtained by decomposing water by shavings of *iron*. A considerable allowance must therefore be made, and instead of calculating the *hydrogen* at one-twelfth, we should reckon it at about one-ninth of the weight of atmospheric air.

With respect to the expense of a balloon of this magnitude, it may be observed, that it would require 440 yards of silk, at 7*s*. per yard; though for ready money, of which we all know the value, it might perhaps be obtained at 6*s*. 6*d*. The expense of the silk, then, would be about 150*l*.; and reckoning 10*l*. for varnishing, 50*l*. for workmanship, and 50*l*. or 60*l*. for the car and netting, the whole expense would amount to nearly 270*l*.

The mode of filling balloons, now generally adopted, is by means of the *gas-pipes*, which is a much cheaper plan than inflating them with *hydrogen*, and relieves the aeronaut from a great deal of care and anxiety; as he has no occasion to trouble himself about the methods of generating *hydrogen gas*. The filling of the balloon depends upon the degree of pressure at the gas-works, and it has been in consequence of a deficiency in this particular, that balloons have sometimes not been properly filled by this method. The quicker balloons are filled, the more likely they are to ascend; for with all the precaution that can be used, they cannot be made perfectly air-tight, and during their inflation, time is allowed for the escape of a portion of the gas through the imperfect parts.

Aerostatic excursions have generally been undertaken with a view to pecuniary profit, though some scientific gentlemen have ascended, and the Lecturer was of opinion that aerostation might be of considerable utility in promoting a variety of scientific objects. Observations might be made, at considerable altitudes, on the vibrations of the *pendulum*, which are known to vary in different latitudes, from the equator to the poles. The *variation* and *dip* of the *magnetic needle* might also be subjected to examination during aerial voyages. The exact state of the air at certain altitudes, might be examined, under different circumstances; for the Lecturer had some doubts whether the atmosphere possessed the same degree of levity over a plain, as at the top of a mountain; or, in other words, supposing the height of a mountain to be 2000 feet, and a balloon to ascend to the same altitude over a plain, whether a cubic foot of air, in both these situations, would be of exactly the same weight. The *electrical* state of the atmosphere, and also its *refracting* power, might form other important subjects for philosophical observation at great altitudes; but unfortunately, these scientific objects have not been attended to of late, in aerial excursions.

Mr. Tatum here again adverted to the first balloon constructed by Mr. Green, of whose intelligence and ingenuity he spoke in the highest terms. He produced a specimen of the manner in which Mr. Green formed the seams of his balloon, the strength of which was tried by attaching weights to the silk, and the result was, as before stated, that the balloon was proved to be stronger at the seams than in any other part. Mr. Green perhaps acted prudently in afterwards sewing the seams, at the request of his friends, but this could not be done without puckering them, and diminishing the neatness of their appearance.

The Lecturer next alluded to the aerial voyages of the celebrated Garnerin, who was introduced to him at his lecture-room, when he was last in England, and left with him a printed paper, containing an account of some of his principal excursions. In this paper, M. Garnerin observed, that a long succession of ascensions had confirmed him in his opinion of the advantage of making nocturnal excursions; and it appeared, from the concise statement of his voyages in the upper regions, that upon one occasion, he travelled 384 miles in 7 hours, being at the rate of nearly 55 miles an hour. On other occasions, he went 245 miles in 9 hours; 337 miles in 17 hours; and finally, at the coronation of Napoleon, he travelled 900 miles in 22 hours; a distance which, the Lecturer believed, had never been equalled by any other aeronaut.

It has been said that, by acting with *sulphuric acid* on *iron*, one-fifth more *hydrogen* is produced, than when *zinc* is employed; but the Lecturer had never found that to be the case. On the contrary, he had always been able to obtain the gas in greater quantity, as well as in a purer state, from *zinc* than from *iron*. Mr. Tatum endeavoured to demonstrate this fact by generating *hydrogen* by the agency of both these metals, but the experiment was not perfectly completed. The quantity of *hydrogen* produced by means of the *zinc*, was indicated by attaching a piece of paper to the outside of the vessel in which it was received over the pneumatic trough. The quantity of *hydrogen* liberated by the agency of the *iron*, and received in the other vessel, was certainly not so great, but, at the close of the lecture, the bubbles of *hydrogen* were still passing up, though slowly; and as far as we could judge, the result of the experiment, if more time had been allowed, would have confirmed the Lecturer's observation.

One reason why the *hydrogen* produced by *iron*, is not so light as that produced by *zinc*, is, that turnings of *cast-iron* are employed in the operation; the consequence of which is, that the *carbonaceous* matter contained in the *iron* becomes converted into *carbonic acid gas*, which is much heavier than atmospheric air; and the production of this gas is avoided when *zinc* is employed. The Lecturer had sometimes found that small balloons, filled with gas from *iron-turnings*, would not ascend, while those inflated by means of *zinc*, ascended very readily. He had therefore requested the apparatus-keeper, Mr. Bluett, to procure the best iron he could get, for the experiments of the present evening, in order to avoid using *cast-iron* for producing the hydrogen that would be reqnired.

Mr. Tatum here filled a balloon, only a few inches in diameter, with *carburetted hydrogen gas*, and observed, that he believed he was the first person who had sent up a *small balloon* filled with this gas. The little balloon rose with great facility to the cieling of the Theatre. The Lecturer then repeated his remark, that it had been denied, even by gentlemen high in the scientific world, that a balloon would ascend, when inflated with this gas. It should be recollected, however, that there are two kinds of *carburetted hydrogen gas*, one of which is only about half the weight of atmospheric air. It is well known, that a balloon filled with this gas has ascended, even though it was not made of silk. Mr. Green, who failed in his attempt at White Conduit House, with a balloon of this kind, afterwards made a private ascent with the same balloon; and though he took another gentleman with him, a more complete and successful ascent was never witnessed.

The Lecturer then repeated the experiment which had failed in the preceding lecture, owing to the balloon being too large, or the vessel into which it was introduced too small (vide page 254). The balloon used upon this occasion did not exceed 3 inches in diameter, and was indeed so small, that, when filled with *hydrogen*, it would not float in the atmosphere at all. Notwithstanding this, when it was placed in a vessel of *carbonic acid gas*, it immediately floated, and when the vessel was inverted, it rose rapidly to the surface. This was an evident proof that the ascent of a balloon depends upon its being of less specific gravity than the medium in which it is immersed; and it is upon the same principle that a ship does not draw so many feet in *salt* as in *fresh* water, because the specific gravity of the former is greater than that of the latter.

We ought always to take advantage of every contrivance that may render an excursion through the atmosphere as safe as possible. Balloons have sometimes burst, and if the rent takes place near the top, the destruction of the aeronaut is almost inevitable; but if a *parachute* be attached to the machine, he may descend in safety, as Garnerin did, in this country, some years ago. The Lecturer here adverted to the violent oscillation which took place in Garnerin's parachute during his descent, and exhibited two moveable diagrams, one of which represented Garnerin's parachute, and the other a parachute on an improved construction, by which, the inconvenience of this oscillation was obviated. The improved parachute was very slightly curved in its form. Mr. Tatum then stated, that he had attached a parachute of each kind to a Montgolfier balloon, which was so contrived, by the ignition of a piece of touch-paper, that both the parachutes were dropped at the same time, and at a considerable elevation. His object was to ascertain which descended soonest, and which oscillated most, and, contrary to his expectation, the improved parachute not only descended without oscillation, but occupied rather more time in its descent than the other.

Two small paper parachutes of the different forms alluded to, were now dropped at the same moment from the upper gallery of the theatre, and the manner of their descent confirmed the observations of the Lecturer, though the height was hardly sufficient to allow of a perceptible difference in the time of their descent.

Mr. Tatum then observed, that it was possible to give a *direction* to the descent of one of the improved parachutes, by a method which could not be applied to the old ones. This was certainly a very desirable object, if a balloon should happen to burst on the sea, or over a marsh or a broad river, as the aeronaut might be able to direct the parachute, even against the wind, and thus avoid the threatened danger. A small car was now suspended to the parachute under which it hung from the *centre* of a horizontal piece of wood, about 8 inches long, and, upon being dropped from the gallery, it descended in a perpendicular direction. The car was then suspended from one of the *extremities* of the piece of wood, and let fall from the gallery as before, but a decidedly *horizontal* motion was now communicated to it, and it descended outside the lecture-table, several yards from the perpendicular. The manner in which the car was suspended was such as to allow the aeronaut to alter its situation with respect to the horizontal bar, by means of lines and pulleys.

The Lecturer next proceeded to an experimental illustration of the science of Aerostation, by inflating a large balloon, in the shape of a *wild boar*. This balloon was made by a very ingenious German, now deceased, who had exhibited extraordinary skill in the formation of balloons of this description, some of which represented persons on horseback, and were so correctly formed, that the features of the persons they were intended to represent might be recognised.

The mis-shapen and crumpled mass which formed the *wild-boar balloon* was now attached to the extremity of a tube, communicating with an apartment beneath the Theatre, in which the *hydrogen* was generated for its inflation. As the gas entered the balloon, it gradually expanded, till the boar burst into his full proportions, and exhibited all the symmetry of his elegant figure, amidst the applause and laughter of the admiring spectators. His involuntary efforts to free himself from the ties which bound him to the earth, afforded sufficient evidence of his *internal energy*; and when, at length, he was with some difficulty liberated from his trammels, the unwieldy brute soared into the atmosphere with prodigious dignity, and seemed to look with contempt on the crowd of humble mortals beneath him. Some necessary assistance was given to his perambulations by means of a string, held by a person in the area before the lecture-table, who conducted him to various parts of the theatre; sometimes directing his aspiring flight to a survey of the lofty lantern of the lecture-room, and sometimes giving him an opportunity of making his obeisance to the spectators in the gallery, and of paying his respects to his friends in the pit. His majestic deportment was witnessed by the audience with shouts of applause, and he at length descended from his altitude, to occupy a more humble station beneath the gallery.

A balloon of a globular form, filled with *hydrogen*, was then sent up, after which, the paper Montgolfier balloon which ascended at the close of the previous lecture was again inflated, by rarefying the air it contained; but upon this occasion, a quantity of flax, dipped in spirits of wine and ignited, was attached to the balloon, so as to burn within it. The balloon was then allowed to ascend, and was confined by a string for the purpose of directing its movements, but in attempting to conduct it through the air, the flame (which was rather large) came in contact with the tissue paper, and the balloon took fire and was destroyed.

A valve is fixed in the upper part of every balloon filled with *hydrogen*, that the aeronaut may be enabled to let out a portion of the gas when he wishes to descend. A model of this valve was exhibited, and also an elegant model of a contrivance for obviating the sudden concussion frequently experienced by aerial travellers when the balloon reaches the earth in its descent. This was effected by attaching elastic springs to the bottom of the car, and the plan seemed extremely well adapted to the purpose intended.

When persons speak of navigating a balloon in the air by means of wings or sails, they should recollect, that unless these wings, &c. are returned *edgeways*, after striking the atmosphere, the action and re-action will be equal, and no effect will be produced; their motion, to be at all effective, should, therefore, resemble what is called *feathering an oar*. The Lecturer here exhibited a model, consisting of four broad surfaces or fans, slightly curved, and attached to an axle, at angles of 45° with the axis on which they were made to revolve by turning a handle. When this apparatus was put in revolution, a current of air appeared to pass between the fans towards the hand of the operator, and it, therefore, seemed possible, by means of a machine of this kind, to produce a current of air, in a direction different from that in which the wind might be blowing.

Mr. Tatum then observed, that Mr. John Evans, son of the Rev. Dr. Evans, had written him a letter, in which he had suggested a method of directing a balloon in the air by an application of the principle of the inclined plane. The Lecturer spoke very highly of Mr. Evans's mathematical and mechanical talents, but stated, that his plan was only applicable to Montgolfier balloons.

Mr. Tatum had now considerably exceeded the time to which the lectures usually extend, and he, therefore, found himself under the necessity of concluding by informing his hearers, that on the following Friday, he should direct their attention to the science of Optics.

LECTURES FOR NEXT WEEK.

Wednesday, February 15th, Mr. FREND's Second Lecture on Geography.

Friday, February 17th, Mr. TATUM's Second Lecture on Optics.

DERBY MECHANICS' INSTITUTION.

This Institution, which was established in August last, has commenced its operations with the most favourable prospects of success. The two first courses of Lectures, were delivered to the Members, on the sciences of Chemistry and Anatomy, by Mr. DOUGLAS FOX, in a manner excellently well adapted to the understandings of his audience, who, by the strong interest they manifested, afforded a striking proof of the immediate benefit of the Institution, and excited a gratifying anticipation of its future advantages. The following excellent remarks, by the Editor of a Derby Newspaper, are prefixed to an interesting Report of Mr. Fox's introductory Lectures:—

"'We know,' says a contemporary writer, 'of no way in which greater good can be done, than by removing ignorance, in which most of the evils of life have their origin.' We believe that this is a truth which is almost universally admitted; and the only question will be, what is the nature of the knowledge that ought to be imparted? First, we would ask the questioner what is the nature of the knowledge that ought to be denied? Here the proof of the negation lies most decidedly with the objector. He that would limit human acquirements, takes upon himself a most serious responsibility: he that asserts for himself, or his class, a monopoly of any species of information is called upon to make his and their title good upon the most uncontrovertible evidence, or he stands forward in a position very little to be envied.—It is with a perfect conviction that all the branches of knowledge are dependent on, and illustrative of, each other, that we rejoice to find no limit or peculiar direction attempted to be given to the acquirements now offered to the operative manufacturers at the MECHANICS' INSTITUTIONS either here, in DERBY, or elsewhere. It is for such Institutions to be general: individuals will afterwards select and pursue the objects of their particular choice. That every person who enters an Institution will receive information there can be no doubt; and whether or not that information tend directly, or only indirectly, to aid him in the pursuits to which he may be by study engaged, or by choice devoted, still, who will say that when he quits its hall, he has not a more enlarged view of the pursuits of his fellow men, and therefore of the general bearings and interests of society? Our labour and daily tasks are frequently, and will be, as they ought to be, generally, the primary objects of our study; but he must have a very narrow capacity himself or a very indifferent acquaintance with human nature, who supposes that the mind of man can be bound down to the contemplation of its daily tasks. It is the perpetual anxiety to relieve ourselves from the tedium of one narrow track of impressions that produces more than half the miseries of society. We are not so much exhausted as we are satiated by the monotony of our daily labour, and we do not so much require repose, as we do diversity of ideas when we have lain down our tools, or withdrawn our long-continued attention from our appointed duties.—We look for a new train of ideas, a new channel of thought; we look, in a word, for the relief of change; and it is from a want of that information which might enable us to participate in the knowledge that elevates and enlarges the understanding, that we are induced to fly to relaxations that degrade us, and to the communication of the lowest animal ideas; which low ideas finding us incompetent to enter into more ennobling discussions, take possession of all the remaining faculties of our heads and our hearts. Hence it is that the plan of the Mechanics' Institutions ought to be acted upon as extensively as possible: it is by such a plan that men acquire enlarged views of society, relinquish their unfounded prejudices, and learn to respect themselves, even when they most closely investigate the propositions and opinions of one another. Men thus instructed, easily comprehend each other, and the relaxations of conversation instead of abasing the soul, become, indeed, a feast of reason."

PROFESSOR FARISH'S ISOMETRICAL PERSPECTIVE.

(Concluded from page 248.)

"THE laying down the timbers of a ship, or making a picture of one, shall be another example.

"Let a vertical isometrical plane be conceived to pass through its keel, and to be intersected by the perpendicular planes passing through the ribs, and by planes parallel to the decks. The isometrical lines, which are the intersections of these, may be measured in the ship, and represented with their proper measures noted down in the picture, which will afford the means of representing the ribs, and laying them down in their proper places.

"If this should be designed for the

purpose of constructing a ship from a given model, it might be sufficient to represent the ribs only on one side; those on the other side being the exact counterparts. If the purpose should be to make use of these lines for a drawing, they need be marked but very faintly, and the artist will have little difficulty when guided by them, to fill up the representation by hand.

"A regular fortification, which we will suppose to have eight bastions, will afford another example.'

"A person not conversant in such a subject, is in general puzzled with plans and sections, and has very little idea of what is meant to be conveyed.

"But he would easily understand it if he should see every thing exhibited in a correct picture, especially where he has the view of his object varied, as in a fortification, such as has been proposed. Let an isometrical ellipse be drawn, expressing the internal circumference of the place; and another concentric one, which marks the salient angles of the fortification on the principles already explained. Draw other guiding lines to every necessary point; the lines of the fortification may be easily transferred from a common plan to the isometrical by the help of the scale of concentric ellipses described above, fig. 7, which will serve also to lay down the length of the bastions and curtains, &c., in whatever direction they lie. Find the elevations of every part on the isometrical scale; and thus the body of the place, the ditches, counterscarp, covered way, glacis, ravelins, and all the outworks, will be represented to the eye as they appear in reality, and in every varied position, with the advantage of having all the admeasurements laid down with geometrical precision.

"If the artist should think the vertical lines in such an exhibition too small to give a correct idea of all the minute elevations, there would be no harm in his increasing the scale in that dimension in any desired proportions.

"The face of a hilly or mountainous country like Switzerland, or the district of the lakes in the north part of England, will afford another example.

"Isometrical horizontal lines may be drawn representing lines in the level from which the height of the mountains is to be reckoned, so that vertical lines drawn from the summits of the mountains may meet them, on which the heights may be marked (as well as recorded in figures if required). And the mountains themselves may be drawn in their topographical situation. Their bearings may be marked by the help of the isometrical compass described in page 246. It would be easy to transfer them from a common map to the isometrical plan; and thus the face of the country might be represented just as it would appear from them the commanding height which the isometrical perspective supposes.

"Yet, as the slopes of hills and mountains are seldom so steep as the line of sight, it might sometimes suit the purpose to represent the height of elevations as twice or three times the reality, in order that mountains might project an outline on the plane behind; otherwise, the summit might be projected on the mountain itself, which would, in a degree, destroy the effect of a picture.

"This art might be advantageously employed also for tracing what is below the surface of the earth, as well as what is above it. It may be applied to geological purposes, and give, not only the order of the strata, but their variations and their geographical situations. And for this purpose, it might be useful to increase the vertical scale, in a great proportion, above the horizontal. It would be easy to mark the dip, or rise of the strata, as well as of the earth above them: to represent their various disruptions; to show the situation and extent of fissures and metallic veins; to mark the boundaries where the upper strata have been swallowed up, or cease to appear, or where the under strata push up towards the day. It would be easy to mark the variations in the thickness of the strata in different places, and to record the result of experiments made at any point, by boring or sinking shafts, which might be done by drawing a vertical line downward, so as to represent the thickness of the laminæ, which might be marked by different colours.

By such a method, the geologist might obtain a map of the country, which might exhibit, at one view, the general results of all the experiments and inquiries that had been made relative to that science. And the owner of an estate might record, in a small compass, all that is known respecting its minerals, and be able, from a comprehensive view of them all, to judge of the probability of success in sinking a shaft, or driving a level. He might also make good use of this perspective in tracing his shafts and drifts in all their windings, elevations and depressions, and comparing them with the surface above, marking also the veins and strata in which they run. For if the artist knows what is beneath the surface, he has no difficulty in representing it as transparent. He must be careful, however, not to perplex himself by lines too much multiplied, and take advantage of his being able to paint the lines with different colours, for the purposes of distinction; and he must use a considerable address in throwing out such lines as would be of little use, and retaining such as will produce the effect of a picture, which should be well preserved, in order to make the exhibition easily intelligible.

"If he should wish to make a drawing of minerals or crystals, this perspective would be well suited to the purpose.

"The point, however, on which the writer of this paper can speak with the greatest confidence is on the representation of machines and philosophical instruments; having been himself so much in the habit of practically applying to them the principles that have been detailed: and this he has exemplified in the plates.

"The correct exhibition of objects would be much facilitated by the use of this perspective, even in the hands of a person who is but little acquainted with the art of drawing; and the information given by such drawings is much more definite and precise than that obtained by the usual methods, and better fitted to direct a workman in execution."

EFFECTS OF SILICA ON POTASH AND FLUORIC ACID.

To the Editor of the Mechanics' Register.

Sir,—In applying, through the medium of your very useful miscellany, for an explanation of the circumstances to which I am about to allude, I beg to premise that my whole stock of chemical knowledge has been derived from the excellent lectures delivered by Mr. Cooper to the Members of the London Mechanics' Institution, of which I shall always have reason to congratulate myself on being one of its earliest Members. If, therefore, my enquiry should appear absurd, my inability to comprehend the valuable instruction I have received, must be my excuse.

In the last lecture delivered by Mr. Cooper, he stated that, in the manufacture of *plate-glass*, by heating *sand* with *carbonate of potash*, the *silica*, or *silex* (for he appeared to use the terms synonimously), during its combination with the *potash*, exhibits decidedly *acid properties*, by forming a *neutral* compound with the *alkali*.

But, in a subsequent part of the lecture, Mr. Cooper, after demonstrating the powerful action of *fluoric-acid gas* upon glass, performed the experiment of *saturating* this gas with *silica*, in which state its *acid properties* appeared to be *neutralized*, as it had no effect whatever on the glass vessel in which it was contained.

In this case, then, the *silica* seemed to exhibit *alkaline properties*, by forming a *neutral* compound with the *acid*; and hence arises the difficulty in which I am at present involved. Am I to suppose that *silica* is both an *acid* and an *alkali*; or, at least, that it partakes of the properties of both? If Mr. Cooper, or any of your intelligent Correspondents, will have the kindness to explain this apparent inconsistency, they will greatly oblige,

Your constant reader,

Fredericus.

FURTHER OBSERVATIONS ON THE THEORY OF THE THUNDER-STORM.

To the Editor of the Mechanics' Register.

Sir,—The friendly manner in which

your Correspondent, R. D. G., discusses this question (See No.71, p.236), is deserving of all commendation; and it is certainly much better calculated to the end in view, than the style of argument which, on a recent occasion, called forth your Editorial censure. R. D. G. has appealed to the worthy President, Dr. Birkbeck, for his opinion relative to the point; but as the time of the learned gentleman is no doubt valuable, and he has already given it upon the theory of Mr. Gordon, which is somewhat analogous, it is probable he may content himself with that declaration.

As R. D. G. has now explained himself more fully as to the theory of Mr. H., I think I am enabled completely to detect its fallacy, and therefore shall beg your excuse for making a few more observations, in order to shew this, and then to have done.

He says, "the formation of *nitrogen*, according to the theory of Mr. H., depends on the agency of electricity. The two gases which form water are chemically combined, when the fluid is decomposed by evaporation, by their opposite states of electricity, and a new substance, viz. *nitrogen*, is the result."

The whole theory, then, is built on the principle, that the two gases which constitute water, are not *chemically*, but *mechanically* combined in its formation, and that they become separated by *simple evaporation;* a supposition which all experience and established facts, decidedly controvert; for, let R. D. G., or Mr. H., evaporate an entire body of water by even the most intense heat (far surpassing what can possibly be accomplished by the action of the sun's rays), and collect the product, they will find it, without the slightest alteration, still to be *water*. Water is, therefore, not to become decomposed by evaporation; and, on the contrary, such is the intimate union of its constituents, that they are not to be separated by the most intense heat we can apply, unless some other body is introduced (such as *iron*), having a greater affinity for one of them, viz. its *oxygen*.

That galvanic electricity has the power of effecting this separation, however, we know by the following experiment, viz. when we place the two opposite wires of a galvanic battery, (even when such wires are not oxidable metals---say of *gold* or *platina*), in a tube containing water, at the distance of about half an inch from each other, a continued stream of gas, viz. *oxygen* from the positive, and *hydrogen* from the negative wires, will be found to proceed from them, so long as the connection is kept up: but this takes place silently, and not by combustion, and only when the electric circle is completed.

In nature, the grand emporium for the production of the electric fluid, we know to be our earth; and it is also ascertained that water, being a prime conductor, when evaporated from its surface, carries a portion of this fluid with it into the atmosphere; which is the mode by which the clouds, termed electric, become supplied. Each cloud, however, that is charged with it is, in this instance, an insulated body, and without the circle of communication between it and our earth; for if the transmission of this fluid each way, was completed, a similar effect, it is clear, could not be produced.

I recollect one of your Correspondents, signed Spes, at p. 347, Vol. II., endeavours to account for the explosion of steam-boilers, not by the expansive force of the steam, but by the agency of the "electric fluid resolving the water and steam instantaneously into *oxygen* and *hydrogen;*" and recommending "some experiments to be made, to explode water or steam at high temperatures, in order to ascertain it. Could this fact be once proved, I have no doubt some theory would, in like manner, be soon built upon it, to account for the phenomena of thunder, &c. although it seems impossible to conceive that vapour could ever be found to exist in the atmosphere, in so highly rarefied and concentrated a state as when generated by the application of intense heat, and confined within the limits of a strong boiler.

R. D. G. seems to think that I had overlooked the agency of *oxygen* being necessary to effect the combustion of *hydrogen gas;* such, however, was not the case, and only omitted on account of its truism; for, had I doubted it for an instant, I had only to glance my eye on one of the street lamps, and there I should have seen, that the fire did not descend into the pipe containing gas, but only burnt at the orifice, where it was combined with the *oxygen* of the atmosphere. Before R. D. G. or Mr. H., however, jumps to a conclusion, they must first establish the fact, of the decomposition of water by evaporation, which is the foundation of their theory.—I have the honour to be, Sir.

Your obedient servant,
G. H.

Leigh Street.

AQUEOUS VAPOUR—DANIELL'S HYGROMETER, &c.

To the Editor of the Mechanics' Register.

SIR,—I have observed with regret, that in the courses of lectures on Chemistry and Pneumatics, given at the London Mechanics' Institution, no explanation has been offered of the laws which regulate the force, density, &c. of aqueous vapour; whether existing singly, or mixed with the atmosphere. And I may add, that I have never yet seen a work on either of the two sciences just mentioned, with both of which the subject in question is connected, in which the same deficiency did not exist. The fact is, I believe, that the subject is very far indeed from being generally understood.

Moreover, I recollect that, many months ago, one of your Correspondents desired to be informed as to which was the best constructed *hygrometer* that had yet been invented? but I have not observed that his letter has hitherto been answered. Also, I noticed, a week or two ago, in your report of Mr. Gowring's fourth lecture on Pneumatics (No.70, p. 212), that although that gentleman described several kinds of hygrometers, he admitted, with respect to all of them, that they are not *measurers* (as their name imports), but merely *indicators* of moisture; and that not one of them furnishes an exact mode of ascertaining the quantity of moisture in the atmosphere. I therefore cannot but infer that Mr. Gowring was ignorant of the existence of any hygrometer of a superior description to those he mentioned; as it would be illiberal to suppose he would have occupied the time of his audience, by describing such imperfect instruments, to the total exclusion of one incomparably superior, had he been aware of the existence of the latter.

Allow me, then, through the medium of your columns, to mention, for the information of all whom it may concern—

1st. That a most masterly and successful investigation was, many years ago, made by Mr. John Dalton, of the whole subject of the force, density, expansion, &c. of aqueous vapour; and that the result of his researches was recorded in a series of essays read to the Manchester Philosophical Society, in October, 1801, and published in the Memoirs of that society, Vol. 5, Part 2.

And, 2dly, That a new hygrometer—the only one worthy of the name—totally dissimilar to all its predecessors, and the use of which consists of a beatiful practical application of a principle established by Mr. Dalton, was invented a few years since by Mr. Daniell; and that a memoir by the inventor, describing its construction, the mode of using it, &c. may be found in the Journal of the Royal Institution, No. XVI.

With respect to the merits of this elegant little instrument, suffice it, for the sake of brevity, to say, that by its means may be ascertained, with perfect precision, the *actual weight* in grains, of aqueous vapour existing in each cubic foot of atmospheric air at the time of observation, as well as the *expansive force* of the said vapour in inches of a column of mercury.

And, with respect to Mr. Dalton's Essays, let me add, that no description, to be attempted, within the short compass of a letter, could fail of doing them injustice. The subject they embrace is so extensive, and the results established so original, so curious, and so valuable, that the papers themselves must be read in order to be appreciated. The extent of the subject they embrace may, in some degree, be inferred from the titles they bear:—they are described as, "On the constitution of mixed gases; on the force of vapour from water and other liquids, at different temperatures, both in vacuo and in air; on evaporation, and on the expansion of gases by heat."

In conclusion, allow me to submit my decided opinion, that you would be rendering an important service, not only to the Mechanics' Institution, but to the philosophical public in general, by re-printing the whole of Mr. Dalton's Essays, as well as Mr. Daniell's Memoir. It would be rescuing from comparative obscurity works, of which the substance ought, undoubtedly, to be incorporated into every book, in which either Chemistry, Pneumatics, or the constitution of the atmosphere, is treated of. Surely, in the present age, when *aqueous vapour* is becoming daily more and more important as a prime mover, every well-established fact relating to its nature is valuable.

I am, Sir,
Your very obedient servant,
J. S.

Thistle Grove, Fulham Road,
February 6, 1826.

TEMPERATURE OF THE ARCTIC AND ANTARCTIC REGIONS.

To the Editor of the Mechanics' Register.

SIR,—At *the Literary and Mechanics' Institution* in this village, on Thursday evening last, a Lecture was delivered by one of the Members on the elementary parts of the science of Geography and the Use of the Globes. The Lecturer in the course of his observations on the *five zones*, remarked, that persons unacquainted with the form and revolution of the globe, and accustomed to associate the idea of heat with the South, were often surprised at hearing it stated that the Antarctic circle is *colder* than the Arctic. Different causes, he remarked, has been assigned for the cold of the South Polar regions being more intense than that of the North. But without detailing the various hypotheses which had been advanced to account for the fact, he proceeded to give the following as in his opinion, the most rational mode of explaining it. "The earth in its annual revolution spends 8 days more in passing from the vernal to the autumnal equinox, than in returning from the latter to the former. The late frost," said he, "must have convinced many of my auditors how great a thickness of ice may be produced by the cold of a single night; and if you take into consideration the effect of 8 days' and nights' frost to which the Antarctic circle has been subjected beyond the Arctic, every year since the Creation—the greater accumulation of ice towards the South than towards the North Pole, will cease to be wonderful.

I am anxious, Sir, to ascertain whether this be a *new* or an *old* hypothesis. I do not recollect to have seen it advanced by any writer on Geography, or by any navigator. If the idea be an old one, you or any of your Correspondents would much oblige me by stating the writer's name and the title of his work.—In the mean time, with your permission, I beg to state, for the information of those of your readers to whom this explanation of a remarkable fact may be new, that by taking the Mosaic account of the Creation for their standard, and considering the age of the world to be 5825 years, this number multipled by eight days for each of those years will give a product of 48056¼ days, and these divided by 365¼ days, will give 128 years 329¼ days. If, for this number of years and days, the South Polar circle has been subjected to the operation of cold more than that of the North, it is surely a time sufficiently long to account for the ice extending much farther from the South Pole towards the South temperate Zone, than the ice in the North Polar circle towards the North temperate Zone.

INQUIRER.

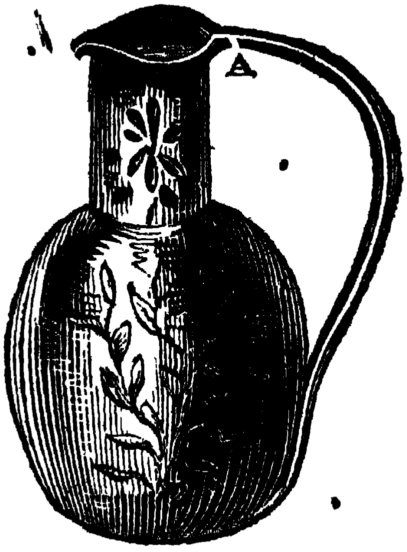
Hackney, Feb. 1, 1826.

CURIOUS JUG.

To the Editor of the Mechanics' Register.

SIR,—I was at a friend's house a short

time back, and there was a very curious old jug introduced, which I was told had been in the family for three or four generations:



The neck was partially cut through all round, in the shape of stars, flowers, &c. so that no one could drink out of it at the top; but the handle was hollow, so that there was a communication from the interior of the jug, at the bottom, up the handle, and half way round the top of it, to the front, (as represented in the sketch). At this part a small piece projected, out of which the company were requested to drink; but there was a small hole underneath the upper part of the handle, at A, over which those that knew of it could place their finger unperceived, and get a good draught; but those who were not in the secret, might draw *air* long enough before they could get anything more. for as fast as they drew it out at the front, it would rush in at the hole A.

W. W.

PRISMATIC COLOURS—RAMIFICATIONS OF PLANTS, &c.

To the Editor of the Mechanics' Register.

SIR,—I wish to call the attention of such of your readers as are curious in observing the various phenomena of nature, to one, which their ingenuity may assist to explain, but which, I am not aware, has ever been satisfactorily accounted for.

On the glass windows of a close stable, and frequently on the bright bars of a grate, we see impressed the whole of the prismatic colours in great brilliancy, and, at this moment, I have affixed on the side of the stove, by which I sit, radiations of these colours, in the precise order in which a ray of light is sub-divided, when seen reflected through a prism. I have heard it said, that it is occasioned by the action of *ammoniacal gas* on the metal, or glass; but what is most remarkable is, that this substance, instead of one, should absorb the whole of the coloured rays, and fix them there, a peculiarity it will require some ingenuity, perhaps, to explain.

Another sport of nature, and which seems to be a favourite arrangement with her in many of her productions, is the branched form, with its almost infinite ramifications, as we see exemplified in the structure of a plant, or tree. During the present frost, we may see on the windows of our room, the moisture arising from our breath, condensed there into the same beautiful formations, minutely articulated, shewing impressions of perfect trees in miniature. And if, when grinding or mixing colour on a pallet, we suddenly strike the smooth surface of the pestle on the colour spread over the surface of the pallet, the air which we force out in doing so, will radiate the colour into a similar impression, and arrangement of form. The veins and arteries of a leaf, and also of animals, adopt the like arrangement, and, certainly, none could be more ingeniously contrived for the distribution of the fluids, to afford nourishment to the remotest extremities of the body. The numerous springs and rivulets uniting to form a river, might be adduced as a further instance of this arrangement; and many others, with a little attention, might be instanced to shew what I have before stated; conformities which, no doubt, have fixed the attention of many, at different periods, and which I only state here, in order to shew, how a careful observer, who looks around him, need be in no want of food on which to exercise his mind, and excite inquiry, from which, both amusement and instruction may be obtained. Wishing the same increase of prosperity to your useful publication this year as in the last,

I remain, &c.

G. H.

TRANSFUSION OF BLOOD.

The extraordinary operation of taking blood from the veins of one individual, and ejecting it into those of another, was lately performed by Dr. Blundell, lecturer on midwifery at Guy's Hospital, upon a poor woman aged twenty-five years. She was, to all appearance, dying from loss of blood, after a severe labour, when Dr. Blundell (seeing the imminent danger of the case) laid bare one of the veins of her left arm, taking care to prevent the blood flowing from the orifice. The husband of the woman, who was a robust man, was then called in, and two ounces of blood taken from his arm into a glass tumbler; this blood was then, by means of a syringe, slowly thrown into the vein of the woman, in the direction of the heart: in about ten minutes the woman rallied and gradually recovered. The syringe was of brass, and well tinned in the inside; a pipe was fixed to the mouth, about two inches long, and of the size of a crow-quill, shaped like a pen at the end, but with a blunt point. All air was carefully expelled from the syringe when used.—*Scientific Gazette.*

ITEMS OF POLITICAL ARITHMETIC.

[From several Authors.]

The whole number of Inhabitants of the earth is supposed to be about 1000 millions, and reckoning thirty-three years for a Generation, the

Deaths in every year must be 30,000,000
in every day... 82,135
in every hour............3,422
in every minute..............57

Suppose the earth to have existed 5700 years, there have been since the creation 171 generations; since the deluge, 134; and since the Christian æra, 53.

The following scale of population has been held tolerably correct, but from the want of registers in several of the countries estimated in it, the accuracy of the calculation is of course not to be vouched for throughout.

Any given space which maintains in Iceland, 1 man—maintains in Norway, 3 men—Sweden 13—Turkey 36—Poland 52—Spain 63—Ireland 99—Switzerland 114—Scotland 119—Germany 127—England 152—France 153—Italy 172—Naples 192—Venice 196—Holland 224—Malta 1103.

Of 3125 deaths, only one is of a person at the age of 100 years or upwards.

The proportion between the deaths of women and those of men, is as 100 to 108.

The greatest number of deaths occur in the month of March, the next greatest in August and September, and the least in November, December, and February.

Of 1000 deaths, 250 are in Winter—289 in Spring—225 in Summer—and 236 in Autumn—but in great cities, as Paris and London, the greatest number of deaths are in Winter.

Of old persons the number of those who die in cold weather is to those who die in warm weather as 7 to 4.

The men capable of carrying arms are in general the fourth part of the inhabitants of a country.

QUERIES.

No. 43.

What occasions the horizontal or sifting motion in two-wheel carriages?

Does it arise from the want of elasticity, or owing to the shortness of the springs? Has the stiffness of the shafts, or the particular motion of the horse, any tendency to create it?

Having experienced it in carriages with 4-feet springs, with 3-feet springs, and also in those with an additional hind spring, and never having heard the cause satisfactorily explained, an answer, pointing out a remedy, will much oblige

A Constant Reader,
CLIO.

Brixton, January 24, 1826.

No. 44.

What is the best, cheapest, and most expeditious way of casting plates for a voltaic pile; and if they are to be brought ready for use, and what the expence; and likewise, where they are to be procured?

T. E. B.

No. 45.

I **have** for some time observed, that those who are in the habit of letting out horses and gigs for hire are much imposed upon, by persons driving further than was agreed upon. Now, I am of opinion that some means may be discovered that would prove a check to this dishonest practice, and tend to prevent the consequent cruelty in overworking the poor horses. If, therefore, any of the numerous readers of your scientific and valuable Register, could devise a simple means for this purpose, by attaching any slight machinery to the axle, which would shew the distance gone over (or by any other method), and favour the public with the same, would very much oblige the undersigned,

A. B.

No. 46.

Mr. Editor,— I remember reading, somewhere (I know not where), that the winters were much colder in London than at Edinburgh, although the latter is much more north than the former. But having forgotten the reasons that were assigned for such being the case, and having some doubt about it, I should feel obliged to any of your Philosophical Correspondents, if they would communicate them through your valuable repository to, Mr. Editor,

Your's, respectfully,
INQUIRENDO.

No. 47.

What is the best mode of preserving black-lead drawings, so that they may be cleaned without injuring them?

W. M.

No. 48.

What is the method at present in use for colouring or blueing steel?

A CONSTANT READER.

No. 49.

I **shall** feel obliged to any of your Correspondents who can inform me of the best method of preparing colours for oil-painting, for present use and keeping?

A MEMBER OF THE L. M. I.

No. 50.

What is the best method of staining and burning in glass?

A MEMBER OF THE L. M. I.

No. 51.

The method of purifying quicksilver that is combined with tin?

W. B.

No. 52.

I **should** feel obliged if any of your Correspondents would inform me the best method of varnishing prints and water-colour drawings; also how to clean and re-varnish old drawings and pictures.

J. S.

ANSWERS TO QUERIES.

QUERY, No. 38, Page 208.

CHARRING WOOD.

Charcoal being indestructible by moisture, will explain "why charring the end of a stake driven into the ground" tends to preserve it. But as charcoal is very porous, and would admit moisture through it, some other coating, such as pitch, is necessary to close up its pores. A better substance for this purpose than pitch, however, is the mineral brown paint, sold by Crease and Son, and also the British Colour Company, at Walbrook, which is composed of mineral tar, and the Bristol red earth, mixed together; the former being caustic, answers, in some degree, the purpose of charring the wood, and the latter being principally composed of oxyde of iron, forms a pigment nearly as hard as iron itself; after it has been used hot, that completely shuts out the access of both air and moisture: it is much used by Government for wood much exposed to the weather, and for piles driven into the ground, or under water; but what I would recommend to W. H. H., would be first to clear the end of the post, and then apply over it the mineral paint made hot, observing to coat about a foot higher than where it enters the ground, as the part which soonest decays is at the surface of the ground. Care should also be taken previously, that the wood is thoroughly seasoned, otherwise whatever moisture it contains in it, will be enclosed without the means of escape, and, by this means, be rendered destructive, instead of being beneficial.

G. H.

QUERY, No. 34, page 192.

PREPARATION OF PHOSPHORUS.

IN answer to your Correspondent J. W—s, what is the best method of preparing common phosphorus—The matter from which it was originally obtained was human urine, but in 1769, Gahn, a Swedish chemist, discovered it in bones, and a process was soon afterwards invented by Scheele for obtaining it from them.

In animal bodies the phosphorus exists in combination with oxygen, as *phosphoric acid*, which is farther combined with *lime*, constituting *phosphate of lime*. The art, therefore, of preparing phosphorus consists in decomposing these compounds, for which purpose we have to disunite the *phosphoric acid* from the *lime*, and then to detach the *oxygen* from the *phosphoric acid*. The following is the process now usually employed:

[Our Correspondent then details the process given in our 69th Number, page 208, and concludes his communication as follows:]

Phosphorus may also be easily obtained by mixing a solution of *phosphate of soda* with a solution of *acetate of lead*, in the proportion of four of the former salt to one of the latter; by which a precipitate of *phosphate of lead* will occur; and this by distillation will yield *phosphorus*.

Rye. TYRO.

QUERY, No. 39, Page 203.

MOTION OF A BALLOON IN THE AIR.

SIR,—In answer to the above query, it is only necessary to consider, that the atmosphere, being confined to the earth by the power of gravitation, partakes both of the *rotatory* and *orbicular* motions of the earth; and, consequently, the motions of currents of air, which are the effects of differences of gravity, occasioned chiefly by heat, are no more affected by the motions of the earth, than the movements of a clock are influenced by being in a vessel in motion.

However, although the whole effect is not apparent to us, the motion of the balloon, when the current of air is in the direction of the earth's motion, is really equal to the *sum* of the motions of the earth and the current of air; and, when the direction of the wind's motion is opposite to that of the earth's, the motion of the balloon is equal to the *difference* of the said motions.

S. P.

TO CORRESPONDENTS.

We have to apologize to our numerous readers for the omission of Mr. CHARLES LANE's Lecture on "The Classification of Human Knowledge," which should have appeared in the present Number, but which we are compelled, by unavoidable circumstances, to defer till next week.

Several of our Correspondents will find their communications inserted this week, and others will meet with early attention.

ERRATUM.

Page 187, col. 2, line 9, for "Gertunnu," read "GIRTANNER."

THE LONDON
MECHANICS' REGISTER.

"Happy Britannia! where the Queen of Arts,
"Inspiring vigour, Liberty abroad
"Walks, unconfined even to thy farthest cots,
"And scatters plenty with unsparing hand."

THOMSON.

No. 74.] SATURDAY, FEBRUARY 18, 1826. [Price 3d.

ISOMETRICAL PERSPECTIVE.

Fig 1

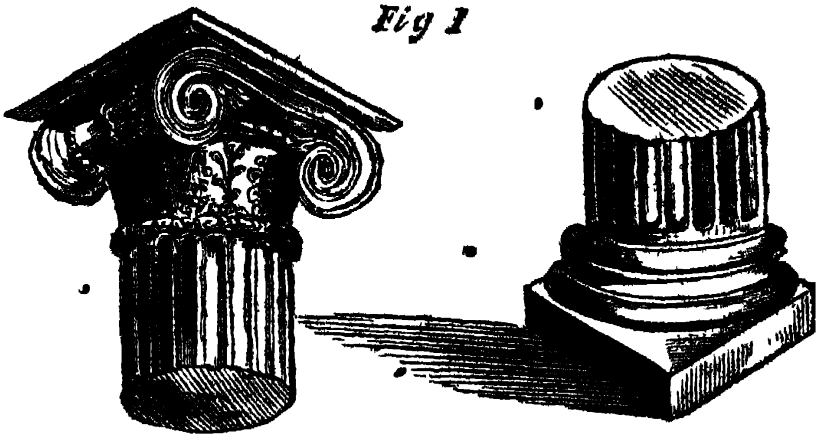
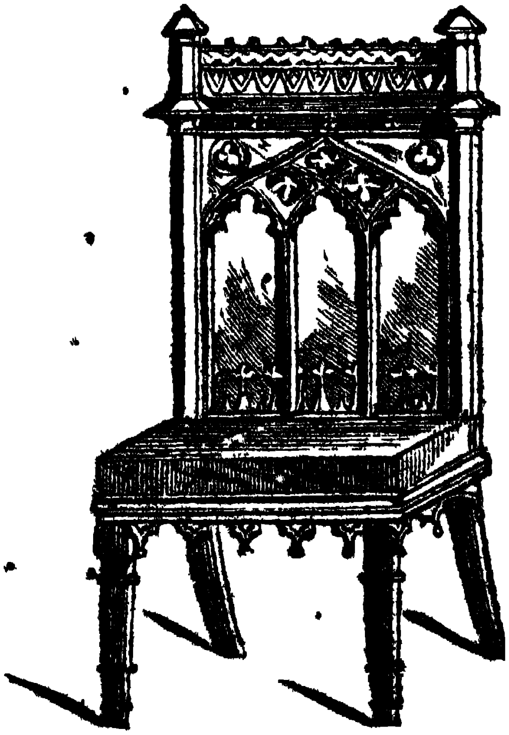


Fig 2



ISOMETRICAL PERSPECTIVE.

We are happy to find that Professor Farish's system of Isometrical Perspective, a minute account of which, we have recently laid before our readers, has been introduced into the Drawing School of the London Mechanics' Institution, by Mr. Davy, the Instructor of the Students, in that department. This gentleman informs us, that the system is highly approved of by his pupils, and he has kindly furnished us with the drawings from which our frontispiece is copied, as specimens of the application of this very useful acquirement. With reference to these drawings, which are finished with great neatness, Mr. Davy observes:—

"It will be perceived by these specimens, that, in Isometrical Drawings, it is not absolutely necessary that all our lines should be *below the eye*. In architectural details, for instance, it would appear quite out of character to represent an Ionic or other Capital, as though it were placed below the eye, when its real situation is generally at some considerable height. It may also be seen, by the view of the chair, that we are not compelled to view it at one of the angles; for the front of the seat may be drawn horizontally, and the sides at angles of 60° from the front line. Professor Farish has not specifically pointed out this method of applying the principles of his system, though he was doubtless aware of it, but his practical application of its rules was, for the most part, limited to the delineation of machinery."

LONDON MECHANICS' INSTITUTION.

MR. CHARLES LANE'S LECTURE ON THE CLASSIFICATION OF HUMAN KNOWLEDGE.

PRELIMINARY REMARKS—LORD BACON'S CLASSIFICATION OF HUMAN KNOWLEDGE—MR. JEREMY BENTHAM'S SYSTEM — ENCYCLOPÆDIAS — MR. LANE'S SYSTEM — KNOWLEDGE — PHYSICS—METAPHYSICS—SCIENCES — ARTS, &c. CONCLUSION.

WEDNESDAY, FEBRUARY 1ST.

Mr. Lane introduced the subject of his lecture, by claiming the indulgence of the Members for the *manner* in which he should discharge his duty, in a situation which was not of an ordinary kind. This, he believed, was the first, or nearly the first time, that one of themselves had undertaken so difficult and responsible a task—that one of the *taught* had been placed in the situation of one of the *teachers*. With respect to the *matter* he should lay before them, he might urge in extenuation, that the sciences illustrated by their lecturers had been taught and approved for many years, and had been very frequently repeated, while the subject he had to submit to their consideration was original. He claimed no merit on this score, and he hoped that, though his subject was a dry one, the Members would not consider their time lost, if they favoured him with their attention for half an hour. He was unable to introduce any attractive experiments, and must therefore content himself with an appeal to their judgment, that they might decide whether he was right or not.

Our present object, continued Mr. Lane, is to create, if it be possible, a system or plan of adjusting all knowledge, so that the learned may be able to make use of all the numerous facts and experiments they have gathered, and the ignorant and untaught may see what is to be learnt, and elect for themselves the proper place for their exertions. These are the grand objects of such a plan, from which would result a better arrangement of the contents of books, and also of the books themselves in large libraries; and now that the Mechanics have the sciences unfolded to them, and many intelligent, but not book-learned minds, are acquiring general knowledge, the time seems peculiarly adapted to a trial of the experiment.

It was observed by a Member, at the last Quarterly General Meeting, that 8 days was too short a time to read an octavo volume. Now, at this rate, the perusal of about 50 volumes might be accomplished in a year; and though ours is but a small library, yet, as it consists of 2000 volumes, it would occupy about 40 years to read it without the least cessation to apply the knowledge acquired. It therefore becomes a matter of considerable importance to adopt some clear and simple plan for the classification of the various branches of knowledge, comprehended in the numerous books by which they are illustrated.

It must not be imagined that this has never been attempted; on the contrary, several plans have been proposed, and my present design is, first to shew you the two most famous systems; next, to observe how little they have been heeded, and what arrangements have been adopted in books; and lastly, to submit my own design.

The first of these systems, in point of date, and the nearest to perfection, is that of Lord Bacon. Mr. Lane here directed the attention of his hearers to a large diagram, exhibiting the various divisions and sub-divisions of Lord Bacon's mode of classifying HUMAN KNOWLEDGE. In this system, the "HUMAN SOUL" occupied the most conspicuous station, as it was the root from which the different kinds of knowledge were derived. The human soul was divided into the three faculties, "Memory," "Imagination," and "Reason." From "MEMORY" proceeded "History," which was divided into "Natural" and "Civil;" and from these descended several sub-divisions. From "IMAGINATION" proceeded "Poetry, or Feigned History," which was sub-divided into "Narrative," "Dramatic," and "Allegorical." From "REASON" was derived "Philosophy," the sub-divisions of which were "GOD, or Natural Theology," "Nature, or Natural Philosophy," and "Man." Under "Man," appeared "Human and Civil Philosophy." "Nature, or Natural Philosophy," was divided into "Speculative" and "Operative," between which appeared "Mathematics," as though it partook of the nature of both, but belonged to neither. "Speculative Philosophy" was divided into "Physics" and "Metaphysics;" and from "Physics" proceeded a variety of sub-divisions, such as "Principles of things," "Structure of the Universe," &c. &c,

Mr. Lane proceeded to observe, that the grand fault in this system was, its beginning with *the thing which learns*, and *disregarding the things which are learned*. With respect to the division of the Human Soul into three faculties, Memory, Imagination, and Reason, it appeared to him very questionable whether the operations of the mind could be at all divided, according to the different effects which it produces; and still more questionable, whether this division was the right one. The Lecturer then made a few observations, in which he offered some objections to Lord Bacon's system, and stated that he should not trouble his hearers with a more detailed examination of it, as he did not wish it to be impressed upon their minds. The table is extracted from his work, "On the Advancement of the Sciences," which Mr. Lane described as being far inferior to his book, called the "Novum Organum."* The latter, if it would not be thought profane, he would call the Mechanics' Bible; for the wisest of us might read it with pleasure and advantage for many repetitions, but unfortunately, there is no good and cheap translation.

The next system to which Mr. Lane adverted was that of Mr. Jeremy Bentham, which he described as being quite as unintelligible as any of that gentleman's writings. This author, said the Lecturer, is unfortunately so well acquainted with the Greek language, and has such a peculiar style of writing, as absolutely to need a translator. Mr. Bentham's extensive table was here exhibited to the audience, on a scale which covered a surface of about 60 square feet; and from the great number of hard words of which it consisted, the necessity of a translator was abundantly evident.

The first word, or main-spring of Mr. Bentham's system is "EUDEMONICS," or "ONTOLOGY," the meaning of which has some connection with *felicity* or *well-being*; so that any knowledge, or art, or science, which does not contribute to well-being, will not be found here. To this system, its author applies the term "*bifurcate*," (which signifies *two-pronged*,) because the first name always includes the two that follow it, and nearly every subject is divided into two parts all the way through. For instance, "Eudemonics," or "Ontology," is either "*Coenoscopic*," or "*Idioscopic*." "Idioscopic Ontology" is divided into "*Somatoscopic*" (body regarding), and "*Pneumatoscopic*" (mind regarding). Mr. Lane pointed out several other examples of the division of the greater branches into two smaller ones, in the course of which such words as the following occurred: — "Anthropurgoscopic Somatics" — "Dicastic Ethics" — "Catanomothetoscopic Judicature" — "Pathoscopic Pneumatology," &c.

Mr. Lane contended that it was as improper to class the arts and sciences according to their moral qualities, as according to the various mental faculties. We should have nothing to do with their effects, either beneficial or mischievous, because we could never persuade men to agree universally in that respect. The impracticability of Mr. Bentham's system may be inferred from its containing no less than 42 articles; each, in his opinion, possessing a different quality, and all these in a statement merely "exhibiting the *first lines* of a tabular diagram of the principal and most extensive branches of art and science, framed in the *exhaustively bifurcate mode*." A school-boy, or even an intelligent mechanic, would have no cause to complain of his memory, who could learn all these hard names in a twelvemonth, and remember their respective places in another.

Thus much for the two systems which have been formed for the classification of human knowledge. Though their authors are entitled to great praise for their intentions, the inutility of their systems must occasion their rejection. People in general will not, at the outset of their studies, learn either a metaphysical system of the human soul, or the Greek language, nor ought they to be expected to do so. These two systems carry their own condemnation on their very face, and are subject to so many objections, that it can never be hoped they will be received.

With respect to the arrangement into which knowledge has been moulded, Mr. Lane objected to the alphabetical form of all the Encyclopædias hitherto published, with one exception only. The alphabetical arrangement is very simple, but not very philosophical; for all the various subjects are mingled together, without the least natural connection. The Encyclopædia Metropolitana exhibits the only attempt at a philosophical arrangement, but even this work is liable to some objections.

Mr. Lane now proceeded to illustrate his own Classification of Human Knowledge, which was exhibited in a large diagram as follows:—

KNOWLEDGE.

PHYSICS.		META-PHYSICS.
NATURE.		MAN.
Matter in General.	MATTER IN GENERAL.	PHILOLOGY.
Motion.	MECHANICS.	LOGIC.
Shape, Space, and Quantity.	MATHEMATICS.	LAW.
Water.	HYDROSTATICS.	GOVERNMENT.
	HYDRAULICS.	———
Air.	PNEUMATICS.	THEOLOGY.
Sound.	ACOUSTICS.	MORALS.
Sight.	OPTICS.	HUMAN MIND.
Heavenly Bodies.	ASTRONOMY.	———
Elements and Actions of Matter.	CHEMISTRY.	HISTORY.
	ELECTRICITY.	BIOGRAPHY.
	GALVANISM.	GENERAL LITERATURE
	MAGNETISM.	CRITICISM.
The Earth. Its Formation, &c.	GEOLOGY.	FINE ARTS.
Its Interior.	MINERALOGY.	———
Its Surface.	GEOGRAPHY.	ASTROLOGY.
Natural History. Vegetation.	BOTANY.	ALCHEMY.
Animals.	ZOOLOGY.	PHYSIOGNOMY.
	or	PHRENOLOGY.
Man.	ANATOMY.	
Mechanic Occupations.		
Trades.		

[Under the head of META-PHYSICS, the reader is at liberty to add his own Details, which should be placed on the right side, or to make a general classification of heads, or qualities, which should be added on the left of the column.]

In framing this system, he had first endeavoured to choose, as a universal head, some word which every body could perfectly understand, and which should always be understood in the same sense. The word "PHILOSOPHY" did not exactly correspond with his ideas on the subject, and he had, therefore, chosen the word

"KNOWLEDGE," as being better English, more comprehensive, and better adapted to the purpose.

It may appear unnecessary, continued Mr. Lane, to tell you that knowledge is *what we know*, and yet this is exactly what I wish, in the first instance, to impress on your minds; for the same reason that a mathematician takes the pains to demonstrate that one angle is equal to another of the same kind, though the result of his demonstration only proves, that angles which are alike, *are alike*. Now, as far as I am able to judge, knowledge very naturally divides itself into two important branches, viz., *matter of fact*, and *matter of opinion*. But I have experienced some difficulty in selecting two words to express these divisions clearly and intelligibly. If I called the first, *natural* knowledge, its opposite would appear to be *unnatural*; and if the term *fact* were applied to it, we should say that *falsehood* was its opposite. I have, therefore, chosen the word "PHYSICS," as the most appropriate term I could select for those branches of knowledge comprehended in the first division; and, to the second division, I have applied the term "META-PHYSICS," which is directly opposed to physics, as it means beyond, or other than physics, and, therefore, completely includes all those kinds of knowledge which cannot be placed under the former head.

If this distribution of knowledge into matter of fact and matter of opinion be assented to, it will be easy to discover under which head to place all the various kinds of knowledge, for nothing but ignorance (allowable ignorance, perhaps,) or wickedness can wish to mis-place any of the subjects which should fall under each of these. All books, or other works of man, must be either a history, or statement, or account of nature,— of the works which are presented in a demonstrable form to his senses; or they must relate to hypotheses, or systems, the results of his own contemplation; not demonstrable to the *senses*, but to the *mind* or *reason*.

I have never met with any very clear definition of the terms "SCIENCES" and "ARTS;" but the knowledge of *nature*, or of the *Works of GOD*, I would venture to call the *sciences*, which I have included under the head of "PHYSICS;" and "META-PHYSICS," under which I have placed the works of man, I would call the *arts*.

Mr. Lane then went through the various sciences which he had arranged under the general title of "PHYSICS," and explained his reasons for the rotation in which he had placed them. For the purpose of rendering the table more intelligible, he had placed common terms opposite to the different sciences, wherever such terms occurred to him, with an explanatory and sufficiently comprehensive meaning.

The Lecturer next referred to the other side of the table, and observed, that it was here that he expected to be most severely criticised, for men seem to shrink from the charge of being metaphysicians. He had placed Philology first on the list of the Arts, because the knowledge of words is absolutely necessary before we can either read or write on any subject. Logic, or the use of reason, comes next; for words may be considered as metaphysical tools, and logic, as the art of using them. Mr. Lane here explained the two famous systems of Logic, framed by Aristotle and Lord Bacon; the former of which was founded on Syllogisms, and the latter upon reasoning by Induction, which the Lecturer considered as the only correct mode of arriving at the truth. Next to Philology and Logic, he had placed Law and Government; but, perhaps, his arrangement might be wrong; in fact, there were 16 articles arranged on this side, and, he was aware, that if he were to ask 16 different individuals whether they were correctly placed, it was probable they would all answer in the negative.

Mr. Lane then adverted to the remaining articles in succession, and with respect to the last four, he observed, that Astrology might be considered as the Metaphysics of Astronomy, Alchemy of Chemistry, and Physiognomy and Phrenology of Anatomy. The whole of these he looked upon as fanciful things, but if it could be proved, that any of them were calculated to further the purposes for which man exists, he should be happy to retract his opinion.

If his general arrangement were considered arbitrary, his division of the Arts into four Classes would, he had no doubt, be considered still more so; for if asked to determine their relative importance to society at large, he should describe the first four, from Philology to Government, as absolutely *necessary* for every individual to be acquainted with. The next division he should say were *useful* matters; the third class, *useless* or *harmless*; and the last, *mischievous*. Any person was, however, at liberty to alter these divisions, and to extend the class comprehending the absolutely *necessary* Arts, as low down the list as he might think proper.

Mr. Lane then observed that, in compliance with the suggestions of his flattering friends, he had published an account of his system, which the Members might have an opportunity of seeing in the Library of the Institution; and he should feel obliged to any of them who would communicate their observations on the subject to him, and point out any errors into which he might have fallen. It was high time that the mists of ignorance were dispelled;—it was with this view, that the Members so frequently assembled, and it was with the hope of contributing towards this desirable object, that he had ventured to occupy their attention this evening.

Mr. M'William then gave notice, that Catalogues of all the Books belonging to the Institution were now printed for the use of the Members, and might be had at the Library, price 6d. each. The Rules and Regulations of the Circulating Library, were printed with the Catalogue, and the Members would observe, that the time during which they were allowed to keep the Books, had been considerably extended.

MR. FREND'S
FIRST LECTURE ON GEOGRAPHY.

INTRODUCTORY OBSERVATIONS—MOTION OF THE EARTH—ITS GLOBULAR FORM—EQUATORIAL AND POLAR DIAMETERS—GREAT AND SMALL CIRCLES—DIVISION OF CIRCLES INTO 360 DEGREES—LATITUDE AND LONGITUDE EXPLAINED—NORTHERN AND SOUTHERN HEMISPHERES—METHODS OF ASCERTAINING THE LONGITUDE AND LATITUDE—CORRECTNESS OF NAUTICAL OBSERVATIONS, &c.

WEDNESDAY, FEBRUARY 8TH.

MR. FREND, a Member of the Committee of Managers, who distinguished himself by his zealous exertions at the original formation of the Institution, afforded another proof of the deep interest he takes in its welfare, by delivering, this evening, the first of a course of Lectures on the very useful science of GEOGRAPHY.

The lecture was introduced by an observation, that one of the ancient philosophers was in the habit of asking himself, every morning, the three following questions:—"Whence did I come?"—"Where am I?"—and "Whither am I going?"—These questions were all of the greatest importance, and it would be well if we were all accustomed to make the same enquiries. Upon the present occasion, his remarks would more immediately apply to the second question, "Where am I?" but he should have no objection, if the Members wished it, to deliver his sentiments on the other two at some future period.

Many of the Members may perhaps suppose, that they are, at the present instant, in the same place as they were when they entered the lecture-room, and took their seats, half an hour ago; but other persons may be bold enough to say, not only that they have removed from the place they occupied, but that they have actually been carried by the motion of the earth, several thousand miles in the course of that time. However bold or remarkable this assertion may be, it is nevertheless true; though some hundred years ago, a person would have been in danger of losing his life for promulgating such an opinion. Mr. Frend here instanced the case of the celebrated Copernicus, who, had he not died almost immediately after the publication of his work on the true motions of the planets, would, in all probability, have been put to death for his opinions. Another instance of a similar kind occurred in the case of Galileo, who, in the year 1632, in the 70th year of his age, was sentenced to imprisonment, and compelled, by the Inquisition, to recant his opinions of the motions of the heavenly bodies. About a hundred years after, the learned Commentators on Newton placed at the head of the volume an avowal that they bowed to the decrees of the Pope, against the motion of the earth, and that declaration was read by the Lecturer.

Mr. Frend then adverted to the form of the earth, which is round, or globular, like that of the moon, which we can discover to be a globe by viewing it through a telescope. It was the opinion of the ancients that the earth was a plane, but if this were the case, a mountain, seen from a distance, would appear entire, however apparently diminished in magnitude; and its most elevated parts would not, as is known to be the case, become first visible to the traveller. Mr. Frend here adduced a variety of other proofs of the rotundity of the earth, such as the approach of a ship at sea, when we be-hold the the tops of the masts before we see the hull; the situation of the polar star in the Heavens, which appears more and more elevated above the horizon, as we approach the north; the circular form of the shadow of the earth on the disc of the moon, during an eclipse of the latter; and finally, the circumstance of the earth having been frequently circumnavigated, by vessels constantly keeping either an easterly or westerly course, and arriving at the place from which they sailed. This had been accomplished, even two or three centuries ago, by our own countrymen, and had since become a matter of ordinary occurrence; and, if this were not a perfect demonstration of the globular figure of the earth, the Lecturer knew of no fact more convincing.

The Lecturer next directed the attention of his audience to the opinions of philosophers respecting a difference in the lengths of the *equatorial* and *polar* diameters of the earth. Newton, in his closet, had predicted, that if its diameter at the equator were 4000 miles, its polar diameter would be 37 miles less. Mr. Frend was, however, of opinion, that we were not yet sufficiently informed on this subject, and he also thought, that if the earth were cut in two at the equator, like an orange, the form of the two parts would not be exactly alike.

The term *globe*, or *sphere*, is derived from a Greek word, signifying a ball; and a globe, or ball, is a body of such a form, that all lines drawn from its centre to any part of its circumference, are *equal to each other*. Mr. Frend, in this, as well as in other parts of his lecture, elucidated his remarks by referring to Mr. Addison's magnificent 36-inch terrestrial globe, which he described as a beautiful specimen of graphic excellence, and a most accurate and faithful representation of the various countries on the surface of the earth. [We had an opportunity of examining this splendid globe after the lecture was concluded, and were much gratified by the inspection. All the late discoveries in the Arctic regions are laid down with considerable minuteness, and the greatest pains have been bestowed in delineating every part of the earth's surface with perfect accuracy.]

If a globe be cut in two by any section passing through its centre, the circumference of the section will be *a great circle*, and the globe will be divided into two *equal parts*; but every other cut or section will produce a *small circle*, and will divide the globe into two *unequal parts*. Thus the *equator* is a great circle, and the two points which are at the greatest distance from it, are called the *poles*, from the circumstance of the earth's turning on an axis passing through those points. The Members are all accustomed to measure straight lines with a common rule, but the method of measuring curved or circular lines, may not be so familiar to them; it is, however, equally easy, as it is only necessary to employ a circular measure, the curve of which corresponds with that of the globe in which the lines are to be measured.

All circles are divided into 360 equal parts, called degrees; each degree being sub-divided into 60 minutes, each minute into 60 seconds, and so on, *ad infinitum.* It is a matter somewhat curious to determine, why 360 should have been first adopted, as the number of parts into which a circle should be divided; but the Lecturer was of opinion, that the ancients imagined that the sun performed his journey through the heavens in 360 days; and, therefore, divided the great circle which he was supposed to describe, into that number of parts.

Mr. Frend here pointed out on the large globe the division of the equator in the manner he had described, and also the same divisions on the brass meridian, which surrounded the globe and crossed the equator at right angles. He then proceeded to explain the mode of determining the situation of places on the surface of the globe, by ascertaining their *latitude* and *longitude*, of which important terms he was anxious to give some plain and familiar definition, as he had frequently heard them confounded, and the one mistaken for the other. Every place may be conceived to have two situations, viz. its real situation on the globe, and its imaginary place on the equator. This place is the point of the equator cut by a line passing from one pole through the place to the other. The *latitude* is the arc of the circle between the place and its imaginary place on the equator. The *longitude* is the arc of the equator between the points of the equator, cut by lines passing through two places and the poles. *Latitude* is always reckoned either *North* or *South* from the great circle called the *equator*, which is at an equal distance from the poles of the earth; and *longitude* either *East* or *West* from another great circle, called the *first meridian*, crossing the equator at right angles, and passing through the poles. In calculating the longitude, it is necessary to choose a *first meridian* from which the distances of all other places, either East or West, are to be reckoned; but this choice is entirely arbitrary, and the English make their first meridian pass through London, as men generally like their own capital city best. The Lecturer here pointed out, as an example, the situation of Grand Cairo on the globe; observing that its *longitude*, or place on the equator, was 31° 23′ *East* of the meridian of London; and its *latitude*, or real situation, was 30° 3′ *North* of its place on the equator.

Geographers generally distinguish the two portions of the earth, North and South of the equator, by the terms Northern and Southern *hemisphere;* a word derived from the Greek, and which any shoolboy at Athens would have known to mean nothing more than the *North half-ball* and the *South half-ball.* From what has been said, it will be evident that any artist can put down on the globe, with perfect accuracy, all places whose latitude and longitude are known. The Lecturer here paid a high compliment to the French geographers, for the great exertions they had made in ascertaining correctly the longitude and latitude of a number of places on the globe, and produced a French work, published we believe annually, in which the situations of all these places are minutely particularized.

There are three modes of ascertaining the longitude of places, viz. by *astronomical observations*—by *trigonometrical calculations*, and by *chronometers*. The first of these methods is, by observing the distance of the moon, from certain fixed stars, or from the sun at any given time, and comparing this observation with the nautical tables, in which the distances of the moon from the sun or star are calculated for the meridian of London; and as these distances are registered in the tables for every day, and for every three hours, the difference between the two observations will give the longitude.

The mode of determining the longitude of places by *trigonometrical observations* is a very arduous task, as it is necessary, in the first place, to measure a base of great length with perfect exactness, and this is a much more difficult task than many persons may imagine. Mr. Frend here related an anecdote of an individual who saw some gentlemen measuring a base of this kind, and expressed his astonishment that so much time and trouble should be taken, merely to measure a line five miles in length. Without such a base, however, no trigonometrical observations can be made at all; but when once it is obtained, the situation of every place in the country where it is measured, and even in the whole world, may be correctly ascertained.

But the simplest and best mode of finding the longitude is by means of *chronometers*. The Lecturer considered the accurate construction of a time-piece as a most important acquisition, and highly applauded Government for the rewards given to those who excel in this useful branch of mechanism. He feared that the artists who *really* made the improvements seldom obtained the rewards, but he hoped they would at least enjoy the applause due to their ingenuity. If we are possessed of a chronometer which, in all parts of the world, will shew the *exact time* at London, the longitude may be readily found, by comparing the precise time at the place where the observation is made, with the time at the same moment in the meridian of London, and reckoning one degree for every four minutes of time, or 15 degrees for every hour. If the time, at the place whose longitude is required, be one hour *earlier* than at London, the longitude is 15° *West;* and if, on the contrary, it be one hour *later*, the longitude is 15° *East.*

The *latitude* of any place is very easily found by trigonometry; indeed, the operation is so easy, that any officer, after being a month on board a ship, can accomplish it with perfect correctness, as it is only necessary to take the *altitude* or *height* of the sun at noon, and compare it with the sun's *declination*, as calculated in the nautical tables. In the Northern hemisphere, the altitude of the polar star will also give the latitude; because this star is in the *horizon* at the *equator*, and its altitude increases from the equator to the North pole, where it is in the *zenith*. The latitude is equal to the height of the polar star above the horizon.

The Lecturer then related one or two anecdotes, to shew the great correctness with which nautical calculations can be be made. Two passengers, in the forecastle of a vessel, enquired of the officer in command, after the captain had retired to rest, whether he was instructed to continue sailing all night in the course he was then pursuing? to which he replied in the affirmative. "Then," said the passengers, "we shall be inevitably wrecked before morning." The officer paid but little attention to this remark, but they seemed so earnest in their observations, that he at length called up the captain, who treated their prediction with the same indifference, but was at last prevailed upon to *shorten sail*, though the same course was pursued. As soon as day-light appeared, *breakers* were seen right ahead of the vessel, and it was evident, that the interference of the passengers had saved her from being dashed to pieces on the rocks.

In another instance, the captain of an East Indiaman sailed from Calcutta to Plymouth, without having seen land during the whole voyage; and one evening, when going down to supper, he observed that before supper was ended, the Eddystone light-house would be seen. This was actually the case, and decisively proved the precision with which he had made his calculations.

Mr. Frend concluded his excellent lecture, by observing that, as the usual time was now expired, he should reserve his further remarks till Wednesday next, and in the mean time, he advised the Members to make use of their eyes and consult their globes, when they would find that the science of Geography was by no means difficult to be comprehended.

MR. TATUM'S FIRST LECTURE ON OPTICS.

NATURE OF LIGHT—THEORIES OF HUYGENS AND NEWTON—SOURCES OF LIGHT—THE SUN, ELECTRICITY, COMBUSTION, &C.—CHEMICAL EFFECTS OF LIGHT ON ANIMALS, VEGETABLES, AND MINERALS—DECOMPOSITION OF LIGHT INTO THE THREE PRIMITIVE COLOURS—REFRACTION, &C.

FRIDAY, FEBRUARY 10TH.

OPTICS, said Mr. TATUM, is that branch of science which treats of the phenomena produced by the rays of light passing through various media, and being reflected from various substances or bodies. But before entering upon this part of the subject, it will be necessary to consider the different theories that have been advanced as to the nature of *light*; and also to treat of *the sources of light* and its *chemical effects*; for, without some acquaintance with these facts, the *mechanical effects* of light, when passing through different media, cannot be understood.

Huygens supposed, that *light* was *not luminous in itself*, but existed imperceptibly in the atmosphere, till a vibratory motion was communicated to it by the agency of the sun, or some other luminous body, which produced in us the sense of vision, as the vibration of the air caused by sonorous bodies excited in us the sense of hearing.

Newton, on the contrary, maintained that *light* consisted of extremely minute particles, which emanated from the sun with a velocity equal to 200,000 miles in a second of time; and that these particles were, of necessity, *luminous*. There are, however, considerable difficulties attending both these theories, and though the Lecturer was rather inclined to support that of Newton, he confessed that he felt some difficulty in reconciling it to his mind. If we suppose the particles of light to proceed no further than the Georgium Sidus, a sphere which is hundreds of millions of miles in diameter, must have been incessantly filled and re-filled with these particles ever since the Creation; and if they have been continually emanating from the sun during that time, it is hard to conceive how such an effect can have taken place, without any diminution of the body from which they have been projected. Some philosophers have imagined, that the comets periodically fall into the sun, to supply him with fuel; and if Newton's theory be correct, it would seem as though some such supply were necessary. The theory of Huygens, however, is not encumbered with this difficulty.

The sources of light are various; for whether the sun actually sends forth the particles of light, or merely excites the sense of vision by communicating a vibratory motion to an invisible fluid in the atmosphere, this luminary must still be considered as one of the sources of light. The fixed stars—the combustion of various bodies, of which the lamps in the theatre are an example—Electricity—some kinds of fish in a certain state—and also luminous insects—may all be mentioned as sources from which light proceeds. There may be others, but we have already specified six sources or causes of light.

Light produces a variety of *chemical effects*, which influence the animal, vegetable and mineral kingdoms. Its effect on the animal world may be inferred from the contrast between the healthy appearance of a man who passes his life in an open country, and the sickly picture presented by one who is constantly confined to a shop. In the vegetable kingdom, light affects both the growth and the colour of the plants. Mr. Tatum here illustrated his remarks by facts similar to those adduced by Mr. Partington in his Optical Lectures, (Vol. I. page 198,) and exhibited a head of celery as an example of the effect of light in producing colour; the lower part, which was excluded from the sun's rays, being white, while the upper part was green. Endive, lettuces, &c. afford other instances of a similar kind; and their taste, as well as their colour, is influenced by the presence of light, as the white portions contain more saccharine matter, and are therefore sweeter than the green. Plants secluded from the light, are found to grow faster than those which are exposed to its influence, but are much more sickly in their appearance; and the Lecturer had observed, that fern is more lofty, when growing in a wood, than in an open situation; but that the seed, which is attached to the under sides of the leaves, is neither so plentiful nor so productive in the former case as in the latter. That the odour of plants is also influenced by light, is evident from their superior fragrance in tropical climates.

In speaking of the effects of light on the vegetable world, it may be observed, that dark bodies absorb the rays of light, while light bodies reflect them. The Lecturer had placed his hands at the same time on a dark coloured window shutter and a white column, both equally exposed to the sun's rays, and had found that the former felt hot, while the latter was comparatively cool. From observing the absorption of the rays by dark bodies, Mr. Davis, of Slough, tried an experiment with a grape vine, by painting the wall against which it grew, one half black, and the other white. The result was, that the quantity of fruit was three times greater on the white side than on the other, and that not only its size was increased, but its flavour was improved. A similar difference was also observable in the shoots and leaves.

The effects of light on the mineral kingdom are rendered evident in a variety of ways. Every silk-mercer, haberdasher, or milliner knows that if his goods are exposed in the window, their beauty fades, which is owing to the decomposing property of the rays of light. Plate glass windows are sometimes seen of a purple colour, though perfectly colourless when first put in: the rays of light having produced the alteration. When apartments are painted, particularly in delicate colours (the fashionable salmon colour, for instance), the colours soon fade; but if a picture be hung against the wainscoat, the part which it covers assumes a very different appearance. The chemist is obliged to hide many articles from the light, if he wishes them to preserve the colour they assume when first manufactured. *Muriate of silver* is an example of the effect of light on some chemical preparations. Mr. Tatum exemplified this fact by exhibiting a phial, containing some *muriate of silver* which had been made for some time, and had completely lost its whiteness by exposure to the light. He then made some *muriate of silver* by pouring *muriatic acid* into *nitrate of silver;* the *muriatic acid* decomposing the *nitrate* by its superior affinity for the metal, and forming the *muriate of silver.* The contrast between the colours of the newly made muriate, and of that which had been exposed to the light for some time, was very evident.

Nitrate of silver undergoes a similar change in its colour, by exposure to the light. This was proved by the exhibition of a small tablet which had been covered with nitrate of silver with a camel-hair pencil. A piece of card, pierced with the letters composing the word "LIGHT," had been laid upon it; and, upon exposing it to the sun's rays, the perforated parts had been changed to a brownish colour, so that the word was distinctly legible on the tablet. *Phosphorus* is another substance which loses its white appearance, and becomes of a dark brown colour, when exposed for a few hours to the direct rays of the sun. All these examples are proofs of the effects of light on the mineral kingdom.

Mr. Tatum then drew some powerful sparks from the electrical machine (the theatre being darkened) in order to shew that Electricity is one of the sources of light, but in this case no effect of combustion is produced. Other instances occur in which light is produced without combustion, to effect which, both a combustible body and a supporter of combustion must be present. The Lecturer here produced a degree of light by rubbing two pieces of *quartz* together, and also by striking together two pieces of *cane,* which he observed is coated with *siliceous matter.* Light was also produced by directing a stream of *hydrogen gas* upon some *platinum,* by means of the elegant piece of apparatus presented to the Institution by Mr. Brougham. Both the *hydrogen* and the *platinum* were of the same temperature as the atmosphere, yet the latter was almost instantly heated red-hot, and ignited the jet of *hydrogen*.

It has been doubted whether, during combustion, the light is produced by the *combustible* or the *supporter of combustion*. It has been thought that it is produced at the expense of the atmosphere, which would confirm the theory of Huygens; but the Lecturer was of opinion that both the combustible and the supporter of combustion contribute to the production of light. If combustion be produced by igniting *hydrogen* or *carburetted hydrogen*, we are sensible that the light does not proceed from the sun. Whence then does it arise? It must proceed either from the combustible, or the supporter of combustion, or both. That the combustible body has some effect on the *colour* of light will be evident by igniting *hydrogen*, *carburetted hydrogen* and *oil-gas*. This the Lecturer did, and after observing that the three gases were all burning in the same supporters of combustion, remarked that the difference in their colour must arise from the combustibles themselves. *Nitrate of strontia* and *nitrate of copper* were also ignited by means of *alcohol*, the former of which burnt with a red, and the latter with a green flame, and afforded a further confirmation of the Lecturer's remarks.

The Members have doubtless observed the red appearance of the sun on a foggy morning. This arises from the moisture in the atmosphere being in a certain state of mechanical division, which prevents any of the rays of light, except the red ones, from passing through. For light, though it appears to be a simple substance, is really a compound body, and is composed of yellow, red, and blue rays. As soon as the whole of the sun's rays can penetrate the atmosphere, the light becomes white.

Yellow, *red*, and *blue* are the three *primitive colours*, from which all the tints of the rainbow are formed, and some artists use only these three colours to produce all the others; as *yellow* and *blue* mixed together form *green*, *yellow* and *red*, *orange*, &c. Mr. Tatum here referred to a diagram, consisting of two concentric circles, the inner circle being divided into three equal parts, and exhibiting the three primitive colours, and the outer circle representing the various gradations of colour produced by their mixture in different proportions. Two phials, one containing a *yellow*, and the other a *red* liquid, were then held before a lamp, and upon looking through them both at the same time, an *orange* colour was seen. A similar experiment produced a *green* colour by means of two phials filled with *yellow* and *blue* liquids.

If the rays of light be composed of the three colours already mentioned, it may be asked why they appear *white* in nature? To exemplify this effect, a circular piece of wood, painted like the preceding diagram, with the three primitive colours, was whirled rapidly round on its axis, when the three colours, by their union, assumed a colour resembling that of whited-brown paper; and the Lecturer observed, that if the rotation were sufficiently rapid, they would appear perfectly white. He could not, however, make the circle revolve quite so fast as at the rate of 200,000 miles in a second.

Mr. Tatum finally adverted to the *refraction* which takes place in the rays of light when they pass from a *rarer* into a *denser* medium. This important principle in the science of optics he illustrated by means of a large basin, on the interior of which three black circles were painted. He requested those members who could see the experiment, to look at the basin in such a direction that its edge should just hide the black circles. Water was then poured into the basin, when the *refraction* of the rays of light, in passing from the *air* into the *water*, brought the circles successively into view. The Lecturer concluded by observing, that he should continue the subject of *refraction* in his next Lecture.

LECTURES FOR NEXT WEEK.

Wednesday, Feb. 22d, Mr. FREND'S Third Lecture on Geography.

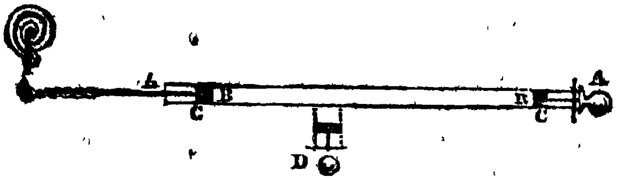
Friday, February 24th, Mr. TATUM'S Third Lecture on Optics.

BELL-HANGING.

To the Editor of the Mechanics' Register.

MR. EDITOR,—Allow me, through the medium of your valuable Register, to suggest an idea or two, on the art of bell-hanging.

I propose the action of two pistons, AA, with solid barrels, BB, fitted into the ends of a tube, as at CC; the space between the solid barrels to be exhausted (or perhaps only partially exhausted) of air; and in order to keep the pistons in their places, I would notice that, at the pull-end, there must be a stop, as shown, appertaining to the knob, or purchase crank, whilst, at the other end, a check-spring, or scroll, of just sufficient strength, may be a part of the bell carriage. The consequence, then, follows, that by drawing the pull-piston, the carriage-piston is forced into the vacuum, and gives the stroke required.



The additional piston, D, is for regulating the exhausted tubes, which may thus be kept always in repair; but they might be even sucked by the mouth sufficiently empty, and a stop-cock near the mouthpiece. Now these pipes may be bent to any corner, or let into walls, or under floors, and thus prevent the awkward appearance of slack wires and unseemly cranks, so much an eye-sore in beautiful cornices and paper borderings. But the bell-hanger asks, "How is my *main* to be done?" I advise him to add another idea to this, if he can; and if not, this is but a single pull. Perhaps in my second suggestion I may be allowed to have introduced something of more universal use to the tact.

That bells on springs and carriages, with check-springs, as now used, are not very elegant, I will suppose to be admitted; and it is no question that they are often out of repair, therefore I opine the plan, as shown, will be admitted an improvement.

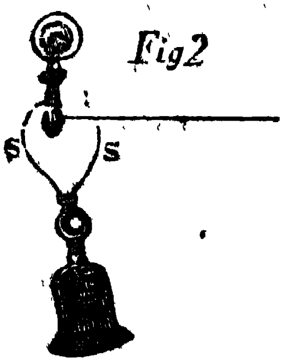


Fig2

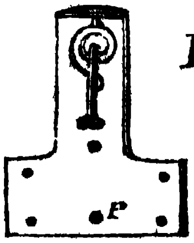


Fig 1

Fig. 1, shows the plate on which the bell hangs, on the pivot P; the other part is the lever, to which the wires are fixed, and against which the scroll spring acts in opposition to the pull.

Fig. 2, is the lever and bell, detached from the plate; the springs, SS, are acted on by the draw and rebound of the lever, and give the bell two or three vibrations, short, sharp, and quick, instead of long, irregular, and lazy.

Your's, &c.

D. D. D.

P. S. I have, in this rough drawing, shown the bell *inclined*; the reason you will know, but I question whether it is needful.

MOISTURE IN THE ATMOSPHERE, &c

To the Editor of the Mechanics' Register.

SIR,—HAVING sufficiently recovered from the Junius-like castigation inflicted on me by AMICUS, I venture, with trembling hand, to resume the forbidden pen; for although AMICUS advised me to lay it aside, he doubtless expected to see some more of its productions; and, as I have a little time unprovided for, with your permission, he shall not be disappointed.

I shall answer the paragraphs of his letter in the order in which they occur, requesting your readers to refer to the same, in Number 65 (pp. 137, 138).

1st. Had I been aware of AMICUS being "one who writes what he is pleased to call nonsense," I should, certainly, not have surprised him by applying to him for information: the statement, however, that the information was peculiar to himself, must have moderated his surprise.

2d. It was far from my intention to make any thing like an *attack* upon AMICUS, and if pertness and arrogance are visible in my last letter, I confess them to be intrusions which my judgment ought to have rejected. It is impossible for me to assist him in attributing to any cause the harsh and angry spirit of which he complains, since, whilst I wrote freely, I was not influenced by any such emotions.

From the sentence, "I was ignorant that any part of my letter had been anticipated, and I beg to apologise for my ignorance," AMICUS concludes that I would fain have plagiarism believed to be the offspring of my genius. Cannot AMICUS distinguish between the thing stolen and the theft? "Clear thought" makes a distinction where there is a difference.

3rd. As it will be more to your Correspondent's advantage, that I make him understand the unequivocal expression which is too wonderful for him, than that I supply him with "Reading made easy," I shall endeavour to succeed in that arduous undertaking. A definite idea of what the word *obstruct* signifies, being obviously relevant, allow me to quote a little from Crabb's English Synonymes.

"Obstruct signifies to set up something in one's way."

"Whatever acts upon the path or passage, so as to prevent a person moving *forward*, is an obstruction."

"A dam *obstructs* the course of a river."

When a river divides into two courses, is it not apparent, that by *obstructing* the water in one, its motion would be accelerated in the other?

What is the course of the known acceleration of water between the piers of a bridge? is it not that the piers *obstruct* the water, and thereby *accelerate* its motion between them?

For a certain quantity of a fluid to pass through a less passage, in the same time that it passed through a greater, its motion must, of course, be accelerated; consequently, any obstruction lessening the passage of a fluid, would, by *obstructing* that fluid, *accelerate* its motion.

4th. It is unnecessary that I refute this paragraph, since each of your readers, by referring to your 57th Number, can do that for himself; and reference to A MANUFACTURER'S Letter, in Number 58, will evince, that one thinking individual coincided with A JUVENILE PHILOSOPHER.

Permit me just to state that I differ from AMICUS, if he really considers the combustion of steam an absurdity. His explanation of the action (which is, in the case alluded to, the combustion) of steam in Mr. Evans's furnace, being founded on mechanical principles, is, I think, an absurd explanation, but not an explanation of an absurdity.

5th. Here is an ejaculatory decision, alike unfounded and unsupported. I stated, "that the coalescence of the particles is effected by reciprocal attraction, none will doubt." "This (says AMICUS) is all that is required to support my hypothesis." What hypothesis? Not "that at a *greater* elevation the drops of water are at a greater distance from each other than at a *less*;" for their "reciprocal attraction" causing their union, is the very cause of their being at a greater distance from each other at a *less* elevation than at a *greater*. See my letter in the 64th Number.

I cannot define at what distance the reciprocal attraction of the particles ceases to exert its influence; but should AMICUS prove what he states, viz. that my refutation of his explanation of the meteorological fact in question, "is, in itself, contradictory," I shall be delighted with his ingenuity.

AMICUS says (or rather means) that I do not allow the influence of *attraction* in the drops themselves towards each other. When he made this statement, he was answering a letter in which I say, "for by the principle of *attraction* which he (AMICUS) has stated, and their accidental contact, they (grammatically referring to the drops of water) must indubitably coalesce.

6th. It may sound strange, but did

AMICUS read my letter before he answered it? I never pronounced the expression, "*closer approximation*," nonsense. "*Nearer contact*" I pronounced a solecism; and then, as a definition for the more humble mechanic, nonsense. I did not evince it to be either, because I thought it intuitively both. Things *in contact* touch; therefore, things in "nearer contact," are nearer than touching—a natural impossibility.

The egregiousness of my assertion, that what your Correspondent calls "*closer approximation*," is "absolute contact," was not, as I had expected, detected by AMICUS; and from the questions which he so vauntingly asks, one may conclude that he is ignorant of the non-contact of particles. Allow me to present him with a quotation from Murray's System of Chemistry, Vol. I. page 211.

"A solid body is to be conceived of, as consisting of a number of particles of the same nature, kept at certain distances from each other by the agency of caloric." "Any condensation hitherto effected, is *very far* from that in which these particles would be *in contact*, nor perhaps, is such a condensation possible."

In answer to his last question, I beg to state, that A JUVENILE PHILOSOPHER accounts for the increase of the specific gravity in the *first* gradation, by the *approximation* of the particles; in the gradations after the first, by the *closer* approximation of those particles.

May I still be permitted to intrude, in order to observe rather an unfortunate circumstance. This 6th paragraph "is, in itself, contradictory." The first question assumes that certain particles are *in contact*, and the others contradict it, by supposing those particles to approximate.

A JUVENILE PHILOSOPHER.

BLOOD IN THE BODY AFTER DEATH.

To the Editor of the Mechanics' Register.

SIR,—I have not noticed till the present moment that LUTHER has made some observations (vide Vol. II. page 383) on a letter of mine on the blood, or I should have offered a few words in reply, since even his answer is open to correction, and I hope to shew him that my answer was not "totally incorrect," though certainly too concise.

I shall endeavour to prove,

First, that the blood when drawn from its vessels is not *decomposed*, as your correspondent affirms it is, but merely subject to mechanical laws, which, while it circulates through its vessels, it is enabled to resist from some cause.

Secondly, that the quantity of blood must be, strictly speaking, the same in the deceased as in the living body, if there be only a mechanical change.

First, then, the blood when drawn from its vessels, spontaneously divides itself into a solid and fluid portion; to which portions the terms *crassamentum* and *serum* have been applied. Now, are they chemically combined or merely mixed? if the combination depends on affinity, when the components are disunited we should expect to find a change, in which the properties of the compound have disappeared, and been superseded by others. Instead of finding any of these changes we merely discover that a number of red particles, which in the living body the microscope shews to be floating in a fluid called *serum*, spontaneously separate when at rest; is it not more agreeable to analogy to suppose that the change is mechanical, viz. difference in specific gravity? The question now is, what prevents coagnlation? the answer would naturally be, that motion was the source of fluidity; that this is not the case is easily proved, by coagulation taking place, even though it be constantly agitated: it would, then, seem to be the result of the vital principle being fled, a power superior to the laws of inorganic matter, enabling animated bodies to act on all around them, in a manner, contrary to those laws, and necessarily when withdrawn the blood yields to the laws of attraction, and separates into a solid and fluid portion. This is the cause beyond doubt, so that your correspondent was incorrect in affirming it was decomposed.

Second, since blood is a mere *mixture*, composed of two parts, one homogeneous and fluid, and one only *suspended* in the liquor by some connexion with vital energy, and spontaneously separating from it when at rest by its becoming amenable to the laws of attraction, why may it not be called *blood* (as it indeed always is) when this separation takes place? and if he he allows it may be called so, I ask him why there is not the same quantity of blood after death as before?

Your correspondent may now, perhaps, allow, that I have not put my "reputation as a physiologist" in jeopardy so much as he may have endangered his own as a chemist, by saying the coagulation depends on chemical decomposition.

He wishes to know what becomes of the *crassamentum;* I am surprised to hear one who lays claim to "long experience in the practice of anatomy and surgery," and who advises me with so much pedantry to "dissect some dozen or more bodies" (good God! it would cost me no less than 100*l.* to procure them, and a year or two to *cut them up,* to acquire what?) confess his ignorance of a fact so generally known; I will not put him to the trouble of cutting even one, but tell him at once that it is nearly all in the veins, a little certainly being in the minute arteries.

Rye. TYRO.

DR. BLACK'S EXPERIMENT ON CALORIC.

To the Editor of the Mechanics' Register.

SIR,—In two glass vessels, of the same size and weight, Dr. Black put portions of water—5 ounces in each. The water in one of the vessels being frozen by a freezing mixture, the vessel was removed into an atmosphere at 47°, and the ice in it allowed to rise to the temperature of 32°. The water in the other vessel being cooled to 33°, and a delicate thermometer placed therein, both vessels were exposed to the same atmosphere at 47°. Now the quantity of caloric (concludes the Doctor) which the ice had received during ten hours and a half (the time which it took in melting) may be estimated by the quantity communicated to the water in the other vessel, and discovered in it by the rise of temperature it produced; for, as the two vessels were exposed in situations perfectly alike, the same quantity must have been communicated to each.

This experiment appears to me of no value, and the conclusion false; for the sensation of cold produced by a piece of ice, is greater than that produced by water at 33°, whilst if they abstracted the same quantity of caloric in a certain time, they would produce equal sensations, since the abstraction of the caloric is the only cause of the sensation, and the sensation is proportioned to the celerity with which the caloric is abstracted.

Perhaps some of your scientific readers will put me in possession of facts enabling me to appreciate the worthy Doctor's manner of reckoning the quantity of caloric which disappears in the solution of ice.

A JUVENILE PHILOSOPHER.

ELECTRICITY PRODUCED BY FRICTION.

To the Editor of the Mechanics' Register.

SIR,—Observing in your 44th Number (Vol. II. page 253,) a paper on Electricity produced by friction; I am induced to send to send the following, with which your readers may not be acquainted.

Oxalate of lime, obtained by precipitation, and dried in a Wedgwood's mortar at a temperature approaching 300°, until so dry as not to render a cold glass plate, when placed over it, dim, will become in a few moments so strongly electrical, when stirred with a *platinum* spatula, that it cannot be collected together, but flies about whenever it is moved. It requires some little stirring before the particles of the powder are all of them sufficiently electrical to produce this effect. It is found to take place either on porcelain, glass, or metal stirrers; and when well excited the electrical particles are attracted on the approach of all bodies, and when shaken in a small quantity on the cap of the gold leaf electrometer, will make the leaves diverge two or three inches. The effect is not due to temperature, for when cooled out of the contact of air, it equally takes place when stirred; being, however, very hygrometic, the effect soon goes off if the powder is exposed to the air. Excited in a silver capsule, and then left out of the contact of air, the substance remains electrical a great length of time, proving its very bad conducting power; and in this respect surpassing, perhaps, all other bodies. The effect may be produced any number of times, and after any number of desiccations of the salt. *Platinum* rubbed against the powder becomes *negative*, the powder *positive*; all other metals are the same as *platinum*. When rubbed with glass, both being dry and warm, the glass becomes strongly *negative*—the *oxalate positive*; and, indeed, this body appears to stand at the head of any yet tried as to its power of becoming positively electrical by friction. The *oxalates of zinc and lead* produce the same effects.

Rye. TYRO.

CITY OF LONDON LITERARY AND SCIENTIFIC INSTITUTION.

THE affairs of this Institution continue in a state of prosperity highly satisfactory to its Members, who have had constant opportunities of hearing a succession of valuable Lectures on the various branches of Natural Philosophy, as well as on other important subjects. Mr. Lewthwaite is at the present time, delivering a Course of Lectures on the Science of Electricity, and from the ability with which he combined real practical information with amusing experiments, when illustrating the same science at the London Mechanics' Institution, we have no doubt his Lectures will afford equal satisfaction to his present auditors.

NEW PATTERN RAZOR.

EVERY person who has experienced the inconveniences arising from the use of a bad Razor, must be very sensible of the value of a good one. These inconveniences do not, however, always arise from defects in the quality of the instrument, but from its degree of concavity, and its general shape and weight, To remedy these evils, a razor, on a new principle, has been invented by Mr. Palmer, of No. [illegible], Castle Street, Leicester Square (a Member of the Mechanics' Institution), which is formed narrower and thinner from the heel to the top of the blade, with a perfectly flat edge, the whole of which is used, so that the razor is calculated to last longer, as well as to shave with greater ease than the common one Whether Mr. Palmer may have attained absolute perfection in the form of his razors, we will not undertake to determine; but we have tried them, and have found them operate in a very satisfactory manner.

CUTTLE FISH.

THIS fish, during its excursions in the search of food, on the approach of danger to itself, or the more easily to prevent the escape of its intended prey, discharges from the tubular orifice at the breast a quantity of the black fluid with which it is always amply provided, and thus obscures or darkens the water to a great distance round. This practice of the cuttle-fish was well known to the ancients. Our own celebrated countryman, Mr. Ray, draws from this circumstance, a singularly apposite and witty illustration, and observes, that an obscure and prolix author may not improperly be compared to a cuttle-fish, since it may be said to hide himself under his own ink! The black liquor, or ink of the cuttle-fish, when collected and dried, splits or cracks into fragments, which being then ground down and re-dissolved in water, form an exquisite ink of the most desirable black; and the well-known Chinese preparation, commonly called Indian ink, is, in reality, supposed to be no other than the concrete juice of the cuttle-fish carefully managed, perfumed, and at length formed into the ornamented cakes or masses in which we receive it. It may here be observed, that all the species of the genus sepia are provided with a similar fluid, which they use for similar purposes; but that of the common cuttle-fish is of a deeper or blacker colour than in most other kinds. In some species, it is of a reddish brown colour, and from it is prepared, by the Chinese, the brown and reddish-brown varieties of Indian ink which are sometimes seen. *(Scientific Gazette.)*

TO CORRESPONDENTS.

We shall be happy to avail ourselves of the kind offer of Tyro.

Communications have been received from Mr. Dewhurst---T. A.---A Pewter Toy Maker --Mr. G. Pa[illegible]---X. X.---G. Morley--- A Mechanic---K.---A well-wisher---&c. &c.

ERRATUM.

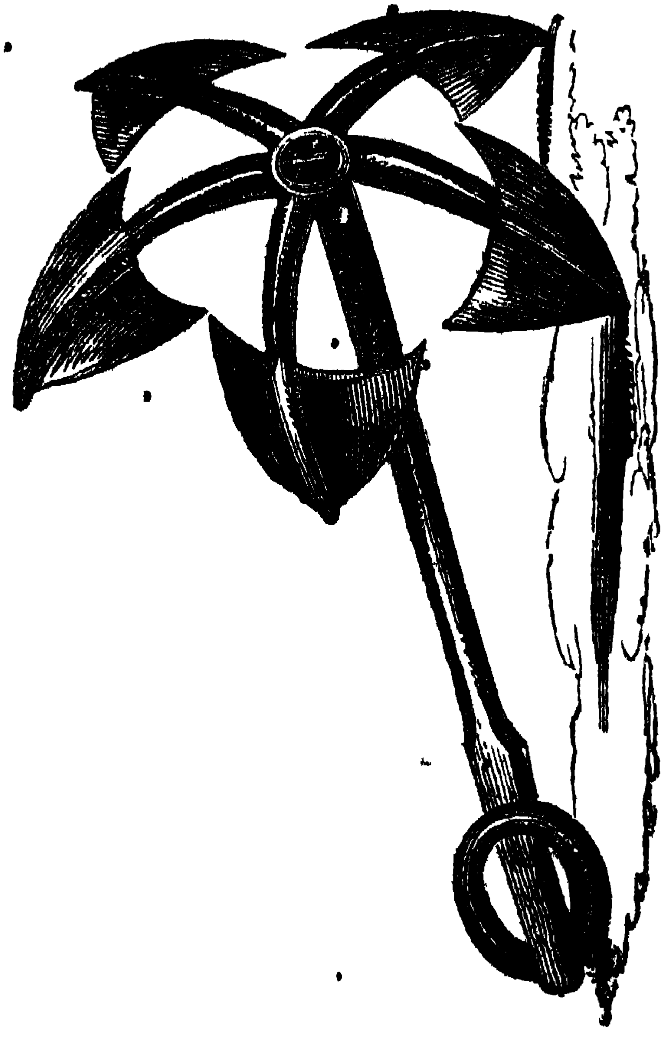
Page 255, col. 2, line 8, for "Crown and Anchor Tavern," read "CITY OF LONDON TAVERN."

THE LONDON
MECHANICS' REGISTER.

"Roused from repose, aloft the sailors swarm,
"And with their levers soon the windlass arm.
"The order given, up springing with a bound,
"They lodge the bars, and wheel their engine round,
"Uptorn reluctant from its oozy cave,
"The ponderous ANCHOR rises o'er the wave."

FALCONER.

No. 75.] SATURDAY, FEBRUARY 25, 1826. [Price 3*d*.

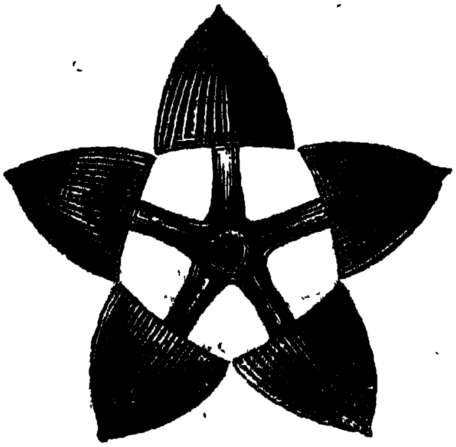


MR. HENRY GOSLING'S NEW-INVENTED ANCHOR

MR. HENRY GOSLING'S NEW INVENTED ANCHOR.

EVERY improvement connected with the welfare and security of the Navy, must be interesting to the feelings of Englishmen, and we are, therefore, happy to lay before our readers an engraving, representing an Anchor, upon a new construction, invented by Mr. HENRY GOSLING, an Officer of His Majesty's Ship Gloucester. We understand that its principle has been highly approved of by many distinguished characters, whose experience in naval affairs peculiarly qualifies them to appreciate it merits.

In the common anchor, the stock, which crosses the shank at right angles with the the two flukes, is used for the purpose of always directing one of the flukes into the ground. The necessity of a stock is obviated in Mr. Gosling's Anchor, as it is furnished with five flukes, radiating from a centre, as represented in the following diagram, so that, in whatever direction it falls, two of the flukes must take the ground.



This arrangement is very advantageous on rocky ground; besides which this anchor possesses other advantages which may be thus enumerated:—

1. That it is particularly calculated for a working anchor with a chain-cable, as a vessel can always ride at single anchor without danger of fouling it.

2. That it stows clear of a large ship's lower-deck ports; not impeding a ship's way as an anchor with a stock does, particularly in smaller vessels.

3. That a chain-cable will never foul it, beyond the certainty of its clearing itself as soon as the strain comes on the cable; thereby capsizing, or turning the anchor over, but leaving it in the same position as when first let go.

4. That a hemp cable must also always clear itself, in the same manner, and leave the anchor in the same position.

5. That by dispensing with the stock, there is not so much danger of the shank snapping.

6. That it may be got on board for casing the ship, or for stowage, with much greater facility than the common anchor, and does not require to be of greater weight than those at present in use

For large ships, the shank should weigh	31 cwt.
Each fluke, 10 cwt.	50
Total weight	81 cwt.

LONDON MECHANICS' INSTITUTION.

MR. FREND'S SECOND LECTURE ON GEOGRAPHY.

OBSERVATIONS ON THE MANUFACTURE OF GLOBES—DELINEATION OF COUNTRIES ON THEIR SURFACES — SCRIPTURAL

ENCOMIUM ON THE MECHANICAL ARTS —NORTHERN, SOUTHERN, PACIFIC, ATLANTIC, AND INDIAN OCEANS — DIVISION OF THE LAND INTO TWO IMMENSE ISLANDS—ISTHMUSES OF DARIEN AND SUEZ — NEW HOLLAND — THE FIVE ZONES OF THE EARTH—DIRECTION OF SHADOWS IN DIFFERENT LATITUDES, &c.

WEDNESDAY, FEBRUARY 15TH.

MR. FREND commenced his lecture by again directing the attention of his hearers to Mr. Addison's splendid terrestrial globe*, and observed that globes are now so common, that persons bestow but little consideration on the manner in which they are formed, or the progressive improvements by which they have been brought to their present perfection. If we look at the beautiful globe before us, and compare it with such globes as were in use 500 years ago, we cannot fail to observe that both science and art must have been employed in perfecting their construction. From the observations made in the preceding lecture, it must be evident that science of the highest degree is necessary, in order to trace the exact course of the sun in the heavens, without which it would be impossible to determine the distances of the various places on the earth's surface from the middle circle or equator. By the aid of science, however, we are enabled to represent the globe, and the situations of the countries into which it is divided, exactly as they are placed on the earth itself; but to accomplish this object, it is also necessary to avail ourselves of the assistance of mechanical art, which has accompanied science in its advances towards perfection.

Mr. Frend then briefly recapitulated the methods of finding the latitude and longitude particularized in his previous lecture, and exhibited a chronometer which had been round Cape Horn. Now, if it be known that a chronometer regularly loses or gains a certain time per day, it is evident that the exact time at the observatory at Greenwich may be ascertained in any part of the globe; and the *longitude* of the place, or its distance from the meridian of London, may be correctly laid down by the mode already described.

The first attempt at the construction of a globe must have been of a very imperfect description, and the globe, in all probability, consisted merely of a rudely formed wooden ball, on which the different countries, whose situations were known, were painted in a rough and unfinished manner. Having discovered a method of delineating places on the globe, the next endeavour was to improve it, by making it more easy of carriage. How this was done the Lecturer could explain the more readily, because he had recently had the good fortune to break an old globe in two pieces. Mr. Frend here exhibited the two halves of this globe, which he observed had seen good service in its time, as it had been in constant use among his young folks, to impress upon their memories the longitude and latitude of the various places on its surface. If we suppose a ball of wood to be covered with successive layers of paper, pasted one over the other, till they become of sufficient thickness, we shall see exactly the method by which globes are formed, so as to be very light and portable. When the paper crust is thus completed, it is divided into two equal parts, and the wooden ball taken out. The two hemispheres are then sewed together, and the globe being provided with an axis, is turned in a machine which makes it perfectly round. It must next be exactly covered with some substance capable of receiving an impression, and the manner in which this is done may be readily conceived by cutting an orange into a number of parts, from top to bottom, and noticing the form of the separate pieces of the rind. Twenty-four pieces of paper, cut into a similar form, and of the same size, are pasted upon the globe, so as completely to cover its surface; but previous to their being put on, they are stamped with the representation of a portion of the earth, so that they present a picture of its whole surface when united.

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* Mr. Addison is now preparing a three-feet celestial globe, which will be a great acquisition to science. The largest globe hitherto published, contains about 4000 stars, but Mr. Addison promises that his new globe shall contain 30,000, including those of the ninth magnitude visible in the Northern latitudes, with their nebulæ and clusters accurately depictured, and their angles made strikingly apparent. From the superior manner in which the divisions of the earth have been marked in the large terrestrial globe, with gradations of characters according to the rank of the place, we anticipate that the promise will be performed.

It is of considerable advantage that the completion of a globe furnishes employment for many persons; for some are employed in forming the globe; others in cutting out the sections or gores which cover it; and others in the very important task of delineating the various parts of the earth on these sections. The skill with which this branch of the work is performed reflects the highest credit on the London artists, who are rewarded for their exertions, not merely by the pay they receive, but by the satisfaction they experience in bringing their art to such perfection. The Lecturer here paid a high compliment to Mr. Arrowsmith for his admirable skill in the construction of maps, and also to Mr. Addison, whose beautiful terrestrial globe so strikingly exemplified his scientific and mechanical abilities in its formation.

Before proceeding further with his illustrations of the science of Geography, Mr. Frend begged leave to make an observation or two on the connection between Science and Art. It appeared to him, that this connection was better understood 3300 years ago than it is at present; for in a book which he held in the highest reverence—a book upon which depends the welfare of mankind both here and hereafter, he found the greatest encomium on the mechanical arts that had ever been pronounced. The Lecturer here referred to the journey of the Children of Israel, during which, the tabernacle was constructed of the costly materials furnished by the Israelites, and Bezaleel and Aholiab were appointed by the Almighty, to carry the work into execution. Mr. Frend then repeated the following passages from the Book of Exodus, chap. xxxv. verse 30, &c.

"And Moses said unto the children of Israel, see, the Lord hath called by name, Bezaleel, the son of Uri, the son of Hur, of the tribe of Judah;

"And he hath filled him with the spirit of God, in wisdom, in understanding, and in knowledge, and in all manner of workmanship.

"And to devise curious works, to work in gold, and in silver, and in brass,

"And in the cutting of stones, to set them, and in carving of wood, to make any manner of cunning work.

"And he hath put in his heart *that he may teach*, both he and Aholiab, the son of Ahisamach, of the tribe of Dan.

"Them hath he filled with wisdom of heart, to work all manner of work, of the engraver, and of the cunning workman, and of the embroiderer, in blue, and in purple, in scarlet, and in fine linen; and of the weaver, even of them that do any work, and of those that devise cunning work."

This passage, repeated the Lecturer, contains the highest panegyric that has ever been passed upon mechanical talent, particularly in that sentence where it is stated, that the Almighty put it into the hearts of Bezaleel and Aholiab *to teach others* the arts which they had acquired. The same Divine spirit is still given to man, in a greater or less degree, and its influence is extended to the humblest workman, who, labouring at the forge, and earning his bread by the sweat of his brow, is sensible of the kindness of the Creator, who has given to every individual some means of improving himself, and of communicating his knowledge to others.

Having given a description of the manner in which a globe is constructed, and shewn the feasibility of delineating on its surface the various countries of the earth, it remains to be considered, what the earth actually is. Now, the globe before us represents the earth, the surface of which is composed of land and water, which are differently coloured on the globe; and, upon turning it, we find, that the water covers about two-thirds of its surface, one immense ocean occupying nearly one half. Many of the Members may have seen the sea; but to those who have not, it is impossible for language to convey an idea of the magnificent spectacle it exhibits when put in motion by the wind. The whole globe is covered with water, except where islands rise out of it, and all the inhabitants of the earth, therefore, live in islands.

As the body of water is of such vast magnitude, it is difficult to preserve a proper idea of it, and it has, therefore, been separated into five divisions. The Lecturer turned the large globe as he proceeded to particularise these divisions, for the purpose of pointing out their relative situations, and observed, that navigators had not been able to reach higher than certain latitudes in their approaches towards the Poles, but as they had found water in every direction in which they had sailed towards them, it might be considered as certain that they were surrounded by water. Reckoning, therefore, about 23½ degrees from each of the Poles, we shall have the extent of the Northern and Southern Oceans. The vast Pacific Ocean constitutes the third division, which extends from the Northern Ocean beyond the extreme point of South America. The name of this Ocean appeared rather singular to the Lecturer, for it certainly could not mean to imply that it enjoyed a perpetual calm. Another great mass of water, called the Atlantic Ocean, extends from the Southern Ocean nearly to the limits of the Northern, and between the Atlantic and Pacific, is situated the Indian Ocean. Now, by keeping these five divisions in remembrance, we shall have a complete idea of all the oceans on the globe.

Between these seas are situated the two immense islands, forming those parts of the earth's surface which we inhabit. The largest of these islands lies to the East of us, between the Pacific and Atlantic Oceans, and the other to the West, on the opposite side of the Atlantic; the former comprehending Europe, Asia and Africa, and the latter, North and South America. Besides these, there is another great island, recently discovered, called Australia, or New Holland; and this vast country, the Lecturer conceived, would, at a future period, become the seat of England's true glory; and that by embracing every opportunity of colonizing the island, her Arts and Manufactures, in the course of two or three centuries, would be spread over the whole of this immense tract.

Mr. Frend now pointed out on the globe, the situation and extent of the vast islands he had named, and observed, that though the Northern shores of America had not yet been discovered, it might be confidently spoken of as an island. *The waters of the ocean, therefore, flow all round the earth,* and this circumstance may lead persons to curious enquiries respecting the nature of the tides, which are generally attributed to the influence of the moon. Of this fact, the Lecturer entertained some doubt, and he would ask whether there would be any tides, supposing that the land covered the greater portion of the earth's surface, and was divided into two or three parts, so that, instead of immense oceans, there were only extensive lakes? He thought not, but leaving others to form their own opinions on the subject, he conceived, that we were yet, in a great measure, unacquainted with the cause which influenced the motion of the tides.

The two great islands first alluded to, bear a resemblance to each other in one particular, for each of them is divided into two parts by an isthmus, or narrow neck of land. Thus, Africa is united to Asia by the isthmus of Suez, and North and South America are connected by the isthmus of Darien, a tract of land not more than sixty miles broad. Projects have been formed, many years ago, to cut canals through these necks of land, to allow the passage of ships of large burden. If this could be accomplished, the voyage to India would be greatly shortened by cutting a passage through the isthmus of Suez, and a direct communication would be formed between the Pacific and Atlantic Oceans, by means of a canal through the isthmus of Darien. The Lecturer then traced upon the globe the course of a vessel, which might, under these circumstances, sail from the port of London, passing from the Mediterranean, through the isthmus of Suez into the Red Sea, and thence across the Indian Ocean into the Pacific. The vessel, after crossing the Pacific Ocean, might then pass between North and South America, through the isthmus of Darien into the Atlantic, and thus be enabled to return to England, after having circumnavigated the globe within a period which, 400 years ago, would have appeared miraculous.

Besides the three large islands already enumerated, there are many others of smaller dimensions, such as Sumatra, Borneo, and our own little island, which does not stand lowest in the scale, for it belongs to about the third rate of islands, and, small as it is, we all have reason to rejoice that we are placed upon such an island.

Having now divided the great mass of waters into five oceans, it must be observed, that there is another division of the globe into five parts. The equator divides it into two equal parts, and taking 23½° on each side of the equator, an immense belt or zone encircles the globe and forms one of these divisions. In the same manner, circles are drawn at the distance of 23½° from each of the poles, which form two other divisions, and the remaining two are the parts which lie between these parallels in each hemisphere.

Thus, the whole globe is divided into five great belts or zones, the names of which are derived from their qualities, or their varieties of temperature. The central, or greatest belt, is called the *torrid*, or *hot zone*. The portions of the globe included within the polar circles are the *frigid zones*, and the intermediate parts are the *temperate zones*, in one of which, our island is situated. The ancient inhabitants of the temperate regions supposed the torrid and frigid zones to be uninhabitable, and that the one was too hot, and the other too cold, for human habitation. We know, however, that many persons go every year to the Indies, and after passing the greater part of their lives in the torrid zone, return to their native country; and we know also, that our intrepid countrymen have lately wintered in the frozen regions of the North, and have found inhabitants who had no stoves to warm them, and even built their houses of snow.

Reasoning *a priori*, it might be supposed that our island would partake more of cold than of heat, because it is situated nearer to the frigid than to the torrid zone, but the experience of the present winter has proved that we can have warm days as well as cold. The fact is, that persons may be frozen to death in the torrid zone, or may enjoy warm and pleasant days in Greenland. In the hot climate of Mexico, the inhabitants are within sight of mountains covered with snow, like Mont Blanc; for the temperature of any place depends not only upon the nature of the zone in which it is situated, but upon its height above the level of the sea.

It may be asked, why is one zone *torrid*, another *temperate*, and another *frigid?* But it should be remembered that, in the *torrid zone*, the sun shines *vertically* twice in the year, and is never further than 23½° from the zenith, which is higher than it reaches at any time in this latitude. The sun is also over the heads of the inhabitants twelve hours out of the twenty-four. In this climate, which forms part of the *North temperate zone*, the sun, during the winter, is not more than eight hours above the horizon; and in the polar regions, or *frigid zone*, there is only one day and one night in the course of the year, each of them being six months long. When the sun begins to rise to the inhabitants of the *frigid zone*, only its edge appears above the horizon, which it encircles for several days before its whole orb is seen. After it has once completely risen, it does not set for six months, but during the whole of this time it never rises higher than 23½° above the horizon; whereas, in the equatorial regions, its vertical beams strike the earth with their utmost force.

Different names have been given to the inhabitants of the different zones, from the directions in which their shadows are thrown by the sun. The names themselves are hardly worth remembering, though the facts from which they are derived are interesting. Under the equator, the inhabitants, at certain times, cast no shadow, and they are therefore called *ascii*. Other inhabitants of the torrid zone are called *amphiscii*, because their shadows are thrown in opposite directions in the course of the day. In our regions, which form part of the North temperate zone, the shadows are always turned towards the North, and in the Southern temperate zone towards the South, and the inhabitants of these two zones are therefore called *antiscii*. Near the poles, the inhabitants are denominated *periscii*, because their shadows go round them, and point in every direction in the course of the day.

Mr. Frend then adverted to the fanciful idea entertained by some persons, that the faculties of men depend on the climate which they inhabit. Greece once occupied an eminent situation in the world, and produced many distinguished men, who considered all the rest of the world as barbarians, and conceived that the Supreme Being had confined all the wisdom of the world to Attica. The poets of Rome, 2000 years ago, called us a nation of savages, entirely separated from the rest of the world,* but at the present time Rome is one-fifth of the size of London, and there is no comparison between the two capitals in intellectual acquirements. In the Lecturer's travels, he had met with good and excellent men—men possessing good hearts, and the best qualifications, though not Englishmen; and he had found that it was possible to live very happily in other places besides England. This was, however, a discovery which the Members need not disclose to every body. (*A laugh.*) Iceland is considered as a cold and disagreeable place to reside in, and yet this very island, in the 11th century, contained a hundred times as many men of learning as England. The Lecturer had been introduced to a Professor from Iceland, and had found him well acquainted with classical and other literature. All these circumstances proved the correctness of his doctrine, that the Supreme Being has not limited the acquisition of knowledge to any particular climate, but that in Hindoostan, in Iceland, in China, or in any other country, men may find ample opportunities for the improvement of their minds.

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* Et penitus toto divisos orbe Britannos. VIRGIL, Ecl. I. v. 67.

——and the Britains quite disjoined from all the world.

The time being now expired, Mr. Frend deferred the further consideration of his subject till the succeeding Wednesday evening.

MR. TATUM'S
SECOND LECTURE ON OPTICS.

OBSERVATIONS ON LIGHT AND HEAT AS COMBINED — EXAMPLES OF LIGHT WITHOUT HEAT—MOONSHINE—LUMINOUS INSECTS, &C.—HEAT WITHOUT LIGHT—BOILING WATER, OIL, &C.—IMPORTANCE OF THE SCIENCE OF OPTICS IN ASTRONOMY, NATURAL HISTORY, &C.—PRISMATIC COLOURS—HUMAN EYE—REFLECTION AND REFRACTION—TELESCOPES AND MICROSCOPES—PHANTASMAGORIA LANTERN, &C.

FRIDAY, FEBRUARY 17TH.

MR. TATUM, after recapitulating the principal points illustrated in his last lecture, on the nature and properties of *light* and *heat*, and its effects on the creation, proceeded to observe, that he had as yet made no remarks on the nature of *light* and *heat*, as combined. Some persons have thought that these two fluids (for as such they must be considered), being so frequently combined, are merely modifications of each other. But if this were the case, they ought to be subject to the same, and not to different laws. To investigate this subject in a few words, we must consider whether *light* and *heat* are always combined together, and the negative of this proposition may be best illustrated by a reference to circumstances which are of constant occurrence, and are open to the observation of every one.

In the first place, with respect to the occurrence of *light without heat*, it may be observed that a very considerable degree of light flows from the moon; but if, on a bright moonlight night, two thermometers are placed near to each other, one of them being exposed to the moon's rays, and the other protected from their influence, we shall not find that the thermometer, in the former case, exhibits the slightest exaltation of temperature. Now, in this experiment, there is a considerable quantity of *light*, without the least appreciable degree of *heat*; and, as we know that the moon shines by reflected light, we should naturally suppose that *heat*, as well as *light*, would be reflected from the sun; but as this is not the case, it follows of necessity, that the *rays of heat* are not reflected like the *rays of light*; and, consequently, that in this instance, *light* and *heat* are not subjected to the same laws.

Other examples of the presence of light without heat may be adduced; such as the light emitted from fish in a certain state, and also from some luminous insects, such as the lantern-fly and the glow-worm. The Lecturer had carried home a glow-worm in his silk-handkerchief, and found that it gave out light enough to enable him to distinguish the time on his watch, but upon placing the insect on the back of his hand, the sensation of cold was produced. Thus, three instances have been given of the presence of light without any exaltation of temperature.

The production of *heat without light* may be witnessed in our ordinary domestic concerns. In boiling water, for instance, an insupportable degree of *heat* is produced, but no *light*. The temperature of boiling oil or sulphuric acid, is much higher than that of boiling water, but still no *light* accompanies the *heat*. From all these circumstances, it is evident, that there may be *light without heat* and *heat without light*. Again, if we cause the rays of light to pass through a prism, we shall find, that the greatest *heat* is not where the greatest light is, but at some distance from it. We have, therefore, a right to conclude, that *light* and *heat* are distinct and separate fluids.

If we appreciate the importance of a science by the useful purposes to which it is applicable, we shall find, that there is scarcely an individual who is not indebted to Optics for some of the advantages he enjoys in the pursuit of his daily occupations. Great numbers o persons are obliged to use some kind of glasses to assist their sight, and if we contemplate the beautiful mechanism of a watch, which is of such general utility, we must see the value of a science upon which the correct manufacture of its minute parts, in a great measure, depends. If we go further, and consider the importance of Optics in Astronomy, we shall naturally reflect how little of this sublime science would have been known without the aid of the telescope, which has enabled Astronomers to penetrate into space; to view the belts of Jupiter and the ring of Saturn; to discover the Georgium Sidus, and to enrich the science with a vast number of other important discoveries. The utility of Optics in the study of Natural History is also obvious, for how many minute objects in the animal, vegetable and mineral kingdoms, must have remained unknown, but for the aid of the microscope. The advantages of this instrument may be appreciated when it is observed, that there are microscopes which magnify a million of times, and which enable us to count a number of lines, apparently as large as the marks made with a pen, on an object not more than the two-hundredth part of an inch in magnitude.

Mr. Tatum here expressed his opinion that, in the generality of cases, the prismatic colours observed, on looking through optical instruments, arise from a number of lines on the surface of the object seen. In looking at the breast of a pigeon, we see the feathers under different angles, which decompose the rays of light, and produce in us the sensation of different colours; for, as was stated in the last lecture, the three primitive colours, by their various combinations, are capable of producing every tint in nature. Many of the Members may have seen Barton's buttons,* which exhibit the prismatic colours, in consequence of the angles produced by a number of extremely fine lines drawn on their surfaces. Now as this effect is produced merely by a mechanical division of the surface into lines, and as we can distinguish fine lines on microscopic objects, we have a right to conclude, that the prismatic colours are produced, in both cases, by the same cause.

The Lecturer next adverted to the exquisite mechanism of the *human eye*, than which no part of the creation exhibits stronger marks of the wisdom of the Creator.* As speaking to Mechanics, who are aware how desirable an object it is to get rid of friction in mechanical operations, he would observe how admirably the construction of the eye obviates any inconvenience from the friction of the lash in passing over its surface, which is lubricated with the tears supplied from one corner of the eye, while, by an admirable contrivance of the Great Author of Nature, they are conveyed away at the other. In the construction of telescopes, the Artist cannot make lenses which will become more or less convex, according to circumstances; but the eye is furnished with certain muscles, by which its convexity can be increased or diminished, so as to accommodate it to the greater or less distance of the objects presented to it.

The audience may recollect the experiment in the last lecture, which exhibited the refraction of the rays of light in passing from a *rarer* into a *denser* medium. Now, it may be considered, that the rays undergo nearly the same refraction in passing from the air into the denser medium, formed by the humours of the eye, as there is nearly the same difference of density between the two media. But this difference does not exist with respect to aqueous animals, because the fluid in which they live, is much more dense than the air which supports land animals. As it is necessary, however, that fishes should be able to see distinctly in order to provide themselves with food, the Creator has furnished them with eyes nearly *spherical;* and as the eyes of fishes are, therefore, much more *convex* than those of land animals, this superior convexity compensates for the rays of light not passing through media of such different densities.

The Lecturer next proceeded to explain, by the assistance of appropriate diagrams and apparatus, the *reflection* and *refraction* of the rays of light, and the forms of the various lenses used in the construction of optical instruments.

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* For a description of Mr. Barton's buttons, which display the prismatic colours with all the beauty of mother-of-pearl, Vide Mr. Partington's Lecture on Optics, Vol. I. page 246.

* Our readers will find a minute and interesting description of the construction of the human eye, in Mr. Partington's Lecture, Vol. I., page 215.

He also described the different principles upon which *refracting* and *reflecting* telescopes are made, but as we have had former opportunities of adverting to the same subjects, a repetition is unnecessary. (Vide Mr. Partington's Lectures on Optics, Vol. I., pp. 199, 213, 247, 248, and Dr. Birkbeck's Lecture on Telescopes and Microscopes, page 66 of the present volume.)

Another point to which the Lecturer alluded was, that objects appear larger or smaller, according to the distance of the spectator from them, because the apparent magnitude of objects depends on the angle under which they are seen, and this angle diminishes as the distance increases. Thus, it was shewn by a diagram, that the figure of a child may actually appear larger than that of a man, when the latter is placed at a greater distance from the eye of the spectator. This circumstance is of importance in Architecture; for if the Architect wishes for instance, to place a figure at a considerable elevation, which shall appear of the same size as another figure standing on the ground, he must make the upper figure much larger than the lower. This was illustrated by a diagram, by which it was seen, that the two figures, to appear of the same magnitude, must be so proportioned as to subtend equal angles with the point from which they are viewed.

Mr. Tatum then observed, that the *refractive power* of lenses is compounded of their *convexity* and their *density*. This was shown by throwing the image of the flame of a lamp upon a screen; the rays of light being made to pass through two glass globes of *equal convexity*, but filled with fluids of *different densities*. The image was thrown clearly and distinctly upon the screen by one of the globes, but when the other was substituted, the image became confused and ill-defined, till the distance of the lamp from the globe was altered. The experiment, therefore, clearly proved that the refraction of the rays of light, on passing through a lens, depends upon its *density*, as well as upon its degree of *convexity*.

After some observations on the kinds of spectacles used for the purpose of correcting defective vision, and which vary in their form, according as the eye possesses too much, or too little convexity, the Lecturer proceeded to the subject of *microscopes*, and spoke in the highest terms of commendation of Mr. Cuthbert's *reflecting microscope*, which was exhibited and illustrated by Dr. Birkbeck, in the Lecture already referred to, (vide page 70).

Mr. Tatum concluded his Lecture by exhibiting the effects of the *phantasmagoria lantern*, for which purpose the lecture-table was lowered to give all the Members an uninterrupted view of the screen upon which the images were thrown. The Theatre was completely darkened, and the images, which consisted of portraits of distinguished characters, &c. first appeared of a small size, but extremely brilliant, and then gradually increased in magnitude; so that they actually appeared as if they were approaching the spectators. Some of the images shown upon the screen, exhibited views of Athens, and other places; and by means of the moveable slides of the *magic lantern*, as it is called, a number of objects, such as men, cattle, ships, &c. appeared to be passing across the picture.

This amusing and interesting optical exhibition was witnessed with loud applause by the Members; and the Lecturer, at its conclusion, stated, that on the following Friday he should commence his remarks on the science of *Electricity*.

Mr. M'William then announced to the Members, that the period was near at hand for the Annual Election of a President, Four Vice-Presidents, and a Treasurer; and the Half-yearly Election of Fifteen Committee Men, in lieu of those going out by rotation. The Rules and Regulations of the Institution stated, that the Election should take place on the first Tuesday in March, and be reported to the Members at the General Meeting on the following evening, the first Wednesday. There was an inadvertent oversight in the formation of this provision, as the first Tuesday did not always occur on the day before the first Wednesday; but as the evident intention of the Rule was, that the Election should take place on the evening previous to the Quarterly Meeting, the Committee had appointed Tuesday, the 28th of February, as the evening when the Ballot will take place, between the hours of 6 and 9 o'clock. The Quarterly General Meeting will, of course, be held on the following evening, Wednesday, the 1st of March, at 8 o'clock precisely.

Mr. M'William added, in reply to numerous enquiries respecting the health of Dr. Birkbeck, that the worthy President was considerably better, though still confined to his room, and he hoped soon to be able to announce his perfect recovery.

The burst of applause which followed this communication, sufficiently testified the deep interest felt by the Members in the health of their excellent President.

LECTURES FOR NEXT WEEK.

Wednesday, March 1st.—This being the evening of the Quarterly General Meeting, the usual Lecture is necessarily postponed till the following Wednesday.

Friday, March 3d, Mr. Tatum's second Lecture on Electricity.

LONDON MECHANICS' INSTITUTION.

LIST OF MEMBERS

NOMINATED AS CANDIDATES FOR THE UNDER-MENTIONED OFFICES, PREVIOUS TO THE ELECTION ON TUESDAY NEXT, THE 28TH DAY OF FEBRUARY, 1826.

The Ballot will commence at Six o'Clock in the Evening, and close at Half-past Nine precisely.

FOR PRESIDENT.

George Birkbeck, M.D. 50, Broad Street.

FOR VICE-PRESIDENTS.

Gilchrist, John Borthwick, LL.D. 11, Clarges Street.
Martineau, John, Esq. *Engineer*, City Road.
Millington, Professor, Bloomsbury Square.
M'William, Robert, Esq. 12, Torrington Square.

FOR TREASURER.

John Key, Esq. Alderman, Abchurch Lane.

FOR COMMITTEE.

CANDIDATES OF THE WORKING CLASS,

From whom not less than Ten are to be chosen.

Abeling, William, *Watch & Clock Maker*, 7, Wynyatt Street—Bacon Ebenezer, *Copper-plate Ruler*, 130, Chancery Lane—Chant, John, *Optician*, 2, Skinner Street—Christie, Peter, *Carver*, 22, Spring Street, Portman Square—Day, Charles, *Silversmith*, 34, St. John's Square—Hackett, John James, *Carpenter*, 10, Gower Place, Euston Square——Jackson, David, *Weaver*, Carnaby Market—Nicholls, John, *Printer*, 12, Margaret Street, Spa Fields—Poole, Henry, *Mason*, 16, Princes Street, Westminster—Roberts, Henry, *Coach-maker*, 5, Castle Street, Oxford Street—Simpson, T. J. *Cabinet-maker*, 1, Clifton Street, Finsbury Square—Thompson, Peter, *Carpenter*, 23, Great Newport Street—Tovey Richard, *Engraver*, 10, Felix Terrace, Islington—Webster, William, *Engineer*, 5, Little Henry Street, Waterloo Road—Whitaker, J. L. *Cabinet-maker*, 5, Thomas Street, Grosvenor Square—Wood, John, *Carver*, 50, Wellington Street, Goswell Street.

CANDIDATES NOT OF THE WORKING CLASS,

From whom not more than Five are to be chosen.

Ash, S. E. *Bead-maker*, 17, George Street, Trafalgar Place, Walworth—Bellew, Peter, *Teacher*, 1, South Street, Berkley Square—Blake, J. F.

7, Albion Terrace, New North Road, Islington—CLIFTON, FRANCIS, *Clerk*, 16, Lincoln's Inn—HARDWICK, H. *Tailor*, 137, Strand—HEMMINGS, JOHN, *Gent.* 51, Penton Street, Somers Town—JOHNSTONE, JAMES, *Messenger*, 32, Southampton Buildings——KEBBELL, JOHN, *Surveyor*, Darby Road, Kingsland Road—LANE, CHARLES, *Printing Ink Manufacturer*, 54, Leonard Street, Shoreditch—MURPHY, THOMAS, *Merchant*, 9, Camden Street, Camden Town—PHILIPE, G. P. *Solicitor*, Middleton Street, Wilmington Square—PRITCHARD, ANDREW, *Mechanical Draftsman*, 18, Picket Street, Strand—STRONG, WILLIAM, *Hatter*, 78, St. James's Street, Piccadilly—TAYLOR, RICHARD, *Printer*, Shoe Lane.

*** As no person is entitled to ballot except he has been a Member *Six Months*, the Votes of those Members who have joined the Society during the present Quarter, must necessarily be rejected, if tendered.

The Members are requested carefully to *efface* the names of those they do *not* vote for, leaving only the names of those they wish to return.

ROBERT CHRISTIE, SECRETARY.

29, *Southampton Buildings, Holborn,*
15th February, 1826.

DR. BLACK'S EXPERIMENT ON HEAT.

To the Editor of the Mechanics' Register.

SIR,—A Juvenile Philosopher (Mechanics' Register, Vol. III. p. 287), requests to be put into possession of facts to enable him to appreciate the value of Dr. Black's experiment on latent heat.

In the account given of the experiment, by your correspondent, it is not stated, that *"the time in which the water acquires the temperature of the surrounding medium"* should be noticed. Not having access to Dr. Black's lectures, I am not aware whether this circumstance is omitted to be mentioned; but if it be omitted, its obviousness must have been the cause.

However, lest the mention of this omission should be insufficient to convince your correspondent of the correctness of Dr. Black's inference, I will suppose the time to be known, and then calculate from his data.

Let the time which the water required to acquire the temperature of the atmosphere be 1 hour, then 47° — 33° =14° is the quantity of heat gained in 1 hour; but the ice was 10½ hours in melting, that is, 10½ times longer than the water took to acquire the 14° of heat; hence, admitting the influx of heat to have been equable, the quantity of heat expended in dissolving the ice is 14° × 10½ = 147°, which is the *latent heat*, or caloric of fluidity of water, according to the above supposition.

Another method by which the latent heat of water may be ascertained, is this: mix 1 lb. of ice at 32°, with 1 lb. of water of the same temperature, and, as soon as the ice is melted, if the experiment be expeditiously performed, the resulting temperature will be only 32°; here, then, 140° of heat have disappeared, which, it is reasonable to suppose, have been absorbed in the liquefaction of the ice.

With respect to the difference of sensation perceived on touching ice and water, both at 32°, it must arise from the different conducting powers of those bodies, and the property which ice possesses of abstracting heat from surrounding bodies, without increasing its own temperature, until it is wholly liquefied.

Yours, respectfully,

S. P

TABASHEER.

The substance called *Tabasheer*, which possesses some very peculiar properties, is stated in Dr. Ure's Chemical Dictionary, to be the *silica* which is found in the hollow stem of the bamboo. In the second part of the Philosophical Transactions for 1819, an interesting account of this singular substance has been given by Dr. Brewster.

Tabasheer is said to be inferior in *refracting power* to all solid and fluid substances hitherto examined. It readily imbibes all the volatile and fat oils, and, indeed, all other fluids. The essential oils are quickly absorbed, and, with the exception of oil of cassia, are as quickly evaporated, while the fat oils are slowly drawn in and remain a long time in its pores; and in all these cases an opacity is produced by a partial absorption, exactly as in the case of water. When the imbibed fluids have a colour of their own, or are tinged with colouring matter, the *tabasheer* exhibits a similar tint, so that it is easy to communicate to it any colour. The *opaque tabasheer*, which retains its opacity when its pores are filled with water, acquires a beautiful transparency from the absorption of the oil of beech-nut; and it is curious to observe a substance like chalk, and consisting apparently of a number of particles in a state of accidental aggregation, converted into a transparent mass which the light freely penetrates in every direction. If *pure tabasheer* be wrapped in a piece of paper, and the paper be set on fire, the tabasheer becomes either black or brownish black, and the black colour increases in depth by the repetition of the experiment; if the blackened tabasheer be brought to a red heat it is restored to its primitive whiteness, and resumes all its former properties.

It appears that tabasheer is of two kinds, the *transparent* and the *opaque*. The specific gravity of the former, when dry, is about 2.412, and of the latter, 2.059. The *transparent tabasheer* has the remarkable property of becoming perfectly opaque and white by absorbing a small quantity of water, and perfectly transparent when that quantity is increased. This effect taking place indiscriminately with all fluids cannot be the result of chemical action; its cause must be therefore sought in the changes which the light suffers in traversing the vacuities of tabasheer. From a variety of experiments, it is found that in both kinds of tabasheer, the quantity of water imbibed exceeds in weight that of the tabasheer itself, of course this substance must be extremely porous, and hence arises its peculiar qualities for the transmission of light.

THOMAS TAYLOR.

London Road.

MR. GREEN'S AEROSTATIC EXCURSIONS.

To the Editor of the Mechanics' Register.

SIR,—On reading the conclusion of Mr. Tatum's Lecture on Aerostation, in the 73d Number of the Mechanics' Register (page 260), when speaking of the failure which took place at White Conduit Gardens, I perceive the name of Green has been substituted for that of Graham. I shall be much obliged by your rectifying the same in your next Number. I here beg leave to observe, that the Mr. Green alluded to, has made upwards of *forty* aerial excursions, and that I, in the course of last summer, made *twelve*, without either of us experiencing a single failure. I feel confident the mistake alluded to could not have originated with the Lecturer, he being conscious it was not Mr. Green who experienced the said failure. As Mr. Green purposes making an Ascent, prior to his leaving town, in the event of which, the mistake alluded to might militate greatly against his interest, your attention to the above, will greatly oblige, Sir,

Your most obedient Servant,

G. GREEN.

Turner Square, Hoxton.

FIRE-PROOF WOOD.

DR. FOCHUS, Member of the Academy of Science, at Munich, is said to have discovered a composition by which he renders wood incombustible; the composition is made of granulated earth, and an alkali. To obtain this composition, the inventor says, you must dissolve some moist gravelly earth, which has been previously well washed, and cleared from any heterogeneous matter, in a solution of caustic alkali. This mixture has the property of not becoming decomposed by fire or water. When spread upon wood, it forms a vitreous coat, and is proof against the two elements. The building committee of the royal theatre have twice publicly tried the efficacy of the composition on two small buildings, of six or eight feet in length, and of a proportionate height; the one was covered with the composition, and the other built in the usual manner. The fire was put equally in the two buildings; the one which was not covered with the composition was consumed, whilst the other remained perfect and entire. The cost of this process is very insignificant compared to its great utility, being about two francs three centimes per 100 square feet.

The royal theatre at Munich has undergone this process, having about 400,000 square feet; the expense of which was about 4 or 5,000 francs.—*(Scientific Gazette).*

ANSWERS TO QUERIES.

QUERY, No. 45, Vol. II. Page 142.

METHOD OF STUFFING AND PRESERVING ANIMALS.

To the Editor of the Mechanics' Register.

SIR,—I feel great pleasure in being able to send the following, in answer to the first query of W. H. (No. 45, Vol. II.), which is principally abridged from a work in my possession:—

Let him lay the animal he intends to skin on its back, and cut through the skin from the middle of the sternum to between the thighs, taking care first to turn aside the hairs. Then divide the skin from the body, placing tow between the skin and body, as he separates them, as far towards the back as possible. Disengage the *arms* from the *rectum;* cut the tail interiorly, and separate each thigh at its junction with the bones of the *pelvis,* He now lays the animal on its side, the back to the left, and the paws turned towards him, he skins the back as far as the shoulder by taking the skin in one hand, and the body in the other, and drawing them in a contrary direction.

When this is done, he cuts the fore-legs at the shoulder-joint, and disengages them from the body. Let him continue to unskin the neck, and pass the head from within the skin, unskinning it as far as the nose, taking care to cut the ears as near as possible to the skull, particularly not to injure the eyelids nor cut the lips too close. He must separate the head from the trunk, taking away all the muscles, so that the bones of the head may be quite bare and clean; scroop out the brains from the *occipital hole,* and return the head back into the skin well cleaned. The fore-legs are to be now skinned, the flesh removed, carefully preserving the ligaments which unite the bones, and the legs returned into the skin,—the hind legs are to be operated upon in the same manner.

It now remains to skin the tail, to do which, he must bare the two or three first joints, and tie them strongly to a cord fastened to a wall-hook; afterwards pass a cleft stick between the cord and the tail, with a hand on each side, he draws the stick towards the extremity, and the tail comes out of its sheath.

Supposing your Correspondent has an animal of the size of a *fox,* he must take a piece of wire of proper strength, about two feet long, bend it at one-third of its length to form an oval of it, smaller than the hand, and twist the two ends together, leaving one of them rather shorter than the other; then measuring the iron by the length of the skinned tail, let him cut it of the same length, independent of the oval. The wire is to be wrapped in flax, constantly increasing it towards the oval. Having rubbed the flax of this *tail-bearer,* as it is called, with a little flour paste to preserve the shape, he is to introduce a little of the preservative, which shall be described presently, into the skin of the tail, and put the tail-bearer into it.

Five pieces of iron wire, of the diameter of a straw, are to be procured, one about a foot longer than the body of the animal, the others rather longer than the legs; each of these is to be pointed at one end. At the unpointed extremity of the longer of these five pieces he is to form a ring, large enough to pass the little finger through; bending the wire back on itself a turn and a half. Another ring is to be formed, so as to come exactly between the shoulders.

Let him anoint the inside of the skin of the neck with the preservative, and introduce some chopped tow; not putting too much, since fresh skin easily dilates. Previous, however, to doing this, he should have anointed the head with the preservative, by thrusting it again into the skin of the neck and applying it, which when done, he should introduce some chopped tow about every part of the head where flesh or muscle existed, and then pass the long iron wire into the middle of the skull. After having stuffed the neck, and taken care that the first ring of the wire which passes into the head, is in the direction of the shoulders, and the second corresponds with the *pelvis*, he passes one of the irons for the legs along the front leg—behind the bone; the point which passes out ought to be under the highest ball of the foot. The wire is to be tied to the bones of the leg by drawing them up within the skin of the body, and afterwards anointed and twisted round with flax, making it equal to the flesh removed.

The fore-legs are fixed, by passing one of the wires through the ring of the body wire, and doing the same with the other side, and then twisting the two ends strongly together by the help of flat pincers. Being twisted, they should be fastened to the middle or body wire by pack-thread; the legs re-placed, and bent, according to the attitude he wishes to give them.

The skin of the belly and shoulder having been anointed and stuffed, he is to sew the anterior part of the opening, and proceed to the hind legs, the wires of which, ought to be rather larger than the fore-legs, and the flax may be bound with a little thread, to prevent its slipping, the oval of the tail-bearer is to be tied to the body-piece.

He will now re-place the body of the animal with chopped tow, using the preservative so as to touch every part of the inside of the skin, and then completely sow up the opening.

The following is the recipe for the preservative or arsenical soap:—

Camphor . . .	5 ounces
Arsenic, in powder	2 pounds
White soap . .	2 pounds
Salts of Tartar .	12 ounces
Lime, in powder .	4 ounces

Cut the soap in small slices, as thin as possible, put them in a pot over a gentle fire, with very little water; taking care to stir it often with a piece of wood; when it is well melted, put in the salts of tartar and powder chalk. Take it off the fire; add the arsenic and triturate; the whole gently. Lastly, put in the camphor, which must first be reduced to powder in a mortar by the help of a little spirits of wine; mix the whole well together.

When it is to be used, put the necessary quantity into a preserve pot; dilute it with a little cold water, until it has the consistence of clear broth; apply this with a brush.

To put the animal on its feet, a board is to be prepared, in which the operator pierces four holes, at distances suitable to the attitude he wishes to give the animal, and puts the irons from the four extremities into them, drawing them with the pincers until the feet rest firm upon the plank. The animal being upright, he gives the attitude to the head; he then places the enamel eyes into the eyelids, which requires much care; for the beauty of a stuffed animal depends chiefly upon the head.

To place the ears properly, if he would have them upright, he must pass a connecting thread through their base, and tighten it until they are sufficiently drawn together.

It will be well to apply a brush dipped in spirits of turpentine to the ears, the nose, the lips, and, above all, the paws; repeating the operation seven or eight times, at intervals of some days.

TYRO.

Rye.

QUERY, No. 51. Page 271.

PURIFYING QUICKSILVER FROM TIN.

IN reply to your Correspondent, W. B., who wishes to know the method of purifying quicksilver combined with tin, I beg leave to say it can be separated by distillation.

TYRO.

Rye.

QUERY No. 42, Page 240.

BRANDY AND WATER QUESTION.

SIR,—As none of your correspondents have as yet answered the Brandy and Water question of G. Morley, I trust I shall be excused for taking that task on myself. Beneath is the answer by common arithmetic. The operation by decimals I have given at full length, but that by fractions being very tedious and protracted, I have inserted merely the beginning and the result, which corresponds exactly with that by decimals. I remain, Sir,

Your's, respectfully,
L. B. W.

BY DECIMALS.

Brandy.

$\left|\frac{1}{10}\right|$ 10 gallons.
1

$\left|\frac{1}{10}\right|$ 9
.9

$\left|\frac{1}{10}\right|$ 8.1
.81

$\left|\frac{1}{10}\right|$ 7.29
.729

$\left|\frac{1}{10}\right|$ 6.561
.6561

$\left|\frac{1}{10}\right|$ 5,9049
.59049

$\left|\frac{1}{10}\right|$ 5.31441
.531441

$\left|\frac{1}{10}\right|$ 4.782969
.4782969

$\left|\frac{1}{10}\right|$ 4.3046721
.43046721

$\left|\frac{1}{10}\right|$ 3.87420489
.387420489

3.486784401

Then,
3.486784401 Brandy.
6.513215599 Water.

10.000000000 Gallons.

Water.

$\left|\frac{1}{10}\right|$ 1 1st gallon.
.1

.9
1 2d gal.

$\left|\frac{1}{10}\right|$ 1.9
.19

1.71
1 3d gal.

$\left|\frac{1}{10}\right|$ 2.71
.271

2.439
1 4th gal.

$\left|\frac{1}{10}\right|$ 3.439
.3439

3.0951
1 5th gal.

$\left|\frac{1}{10}\right|$ 4.0951
.40951

3.68559
1 6th gal.

$\left|\frac{1}{10}\right|$ 4.68559
.468559

4.217031
1 7th gal.

$\left|\frac{1}{10}\right|$ 5.217031
.5217031

4.6953279
1 8th gal.

$\left|\frac{1}{10}\right|$ 5.6953279
.56953279

5.12579511
1 9th gal.

$\left|\frac{1}{10}\right|$ 6.12579511
.612579511

5.513215599
1 10th gal.

6.513215599

By Vulgar Fractions.

$$\begin{array}{l|l}
\frac{1}{10} & 10 \\
 & \underline{\quad 1 \quad} \\
\frac{1}{10} & \quad 9 \\
 & \quad \frac{9}{10} \\
 & \overline{8\frac{1}{10}} \\
\end{array}
\qquad\qquad
\begin{array}{l|l}
\frac{1}{10} & 1 \quad \text{1st gal.} \\
 & \frac{1}{10} \\
 & \overline{\frac{9}{10}} \\
\end{array}$$

and by continuing the operation, we should have

$$\frac{9}{10}\ \frac{72}{100}\ \frac{567}{1000}\ \frac{4374}{10000}\ \frac{32805}{100000}\ \frac{236196}{1000000}\ \frac{1594323}{10000000}\ \frac{9565938}{100000000}\ \frac{48046721}{1000000000} =$$

$$3\,\frac{486784401}{1000000000} = \text{the quantity of brandy; then}$$

$$1\ \frac{9}{10}\ \frac{81}{100}\ \frac{729}{1000}\ \frac{6561}{10000}\ \frac{59049}{100000}\ \frac{531441}{1000000}\ \frac{4782969}{10000000}\ \frac{43046721}{100000000}\ \frac{387420489}{1000000000} =$$

$6\,\frac{513215599}{1000000000}$ = the quantity of water, which, added to the quantity of brandy as above, gives 10 gallons the result.

⁂ Answers, producing the same result have been received from the proposer of the question, and from T. H—h.

SPLENDID SPECIMEN OF TYPOGRAPHY.

We beg to call the attention of our readers to the most extraordinary specimen of typographical excellence that, we believe, was ever yet produced in this or any other country. It is the work of Mr. Johnson, of the Apollo Press, Brook Street, Holborn, the author of an elaborate historical and practical treatise on the Art of Printing, and consists of a beautiful bust of Caxton, surmounting a tablet to the memory of that first of British Printers, to Wynkyn de Worde, Richard Pynson, and others of our early typographers. This is surrounded by a magnificent arch, supported on admirably proportioned pillars of the Tuscan Order, in which, as well as in the arch above, *perspective* has been, for the first time, attempted, to be represented by typography, and it is here kept up with astonishing accuracy and effect throughout. This splendid production of art consists of above 60,000 different pieces of moveable type, and more than 150 distinct patterns of the most tasteful flowers.

In this brief description of so astonishing a production of industry, talent, and art, we have by no means exaggerated, but have rather fallen short of the truth, yet will it be believed, that the Printsellers, almost without exception, have refused to take it in for exhibition and sale, alleging that it is *not a work of Art!* meaning, we suppose, that nothing can be, in their estimation, a work of art, that is not accomplished by the graver or the pencil! Such, however, is the disreputable fact; but we can tell those Printsellers, that it is not only a work of art, but one of *consummate* and *transcendant art*, and one, also, which ought to place the artist far above any such petty jealousies. If, however, it should fail to bring him that pecuniary reward to which he is so justly intitled, it will remain a lasting monument of his patient and laborious industry, his professional skill, and his brilliant and creative imagination; for, to increase the wonder, it is a work purely, of imagination—the artist not having had the slightest sketch before his eyes to guide his operations, to enable him to judge of his distances, or to regulate his proportions, as he proceeded with his extraordinary task. Till it is minutely examined, it has all the appearance of an elegant engraving; and exhibiting, as it does, the complete triumph of typography, its merits entitle it to a place in the British Museum.

Answers to Correspondents in our next.

ERRATUM.

Page 285, column 1, line 6 from the bottom, for "course," read "CAUSE."

THE LONDON

MECHANICS' REGISTER.

> "The richest genius, like the most fertile soil, when uncultivated, shoots up into the rankest weeds; and instead of vines and olives for the pleasure and use of man, produces to its slothful owner the most abundant crop of poisons."
>
> HUME.

No. 76.] SATURDAY, MARCH 4, 1826. [Price 3*d*.

MR. LAKE'S DOUBLE DOOR-HINGE.

Fig 1

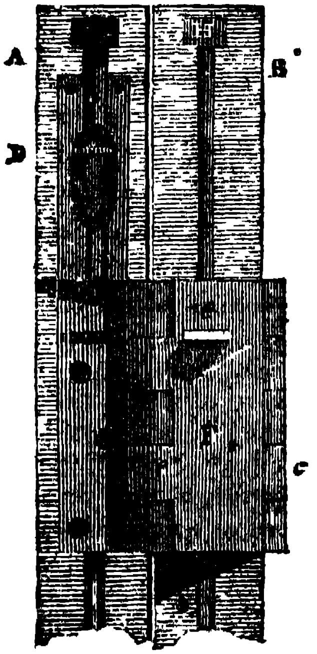


Fig. 2.

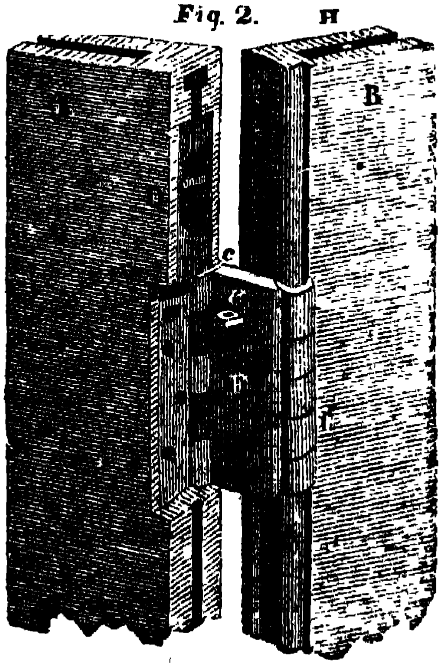
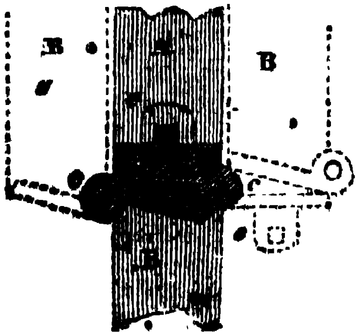


Fig 3



MR. LAKE'S DOUBLE DOOR-HINGE.

The inventor of this ingenious contrivance, was employed by Sir J. Lubbock, to make a door of communication between two rooms, so as to answer the following conditions: that the door be hung on a single jamb or post, that it be divided into two leaves, so that the outer one, when necessary, may be folded back flat to the inner one, by turning either to right or left at pleasure, and that the leaves may, on occasion be fastened together, so as to act as a single leaf.

These conditions are fulfilled by Mr. Lake's Door Hinge, represented in the frontispiece, and the same contrivance is obviously applicable to a window-shutter. Mr. Lake received the Silver Medal of the Society of Arts, as a reward for the ingenuity displayed in this invention.

REFERENCE TO THE ENGRAVING.

A B, the middle style of a double-margined door; F, the hinge, having two joints, *c c*, and consequently three flaps, by which the door will fold on either side, as represented by the dotted lines B on one side, and B *g* on the other (Fig. 3); D. the bolt which, when pushed down, shuts into the staple *e* on the middle flap, and thus fixes one of the joints; the hinge then acts as one in the common construction, and will fold only on the side B *g*; then, by sliding the bolt H (Fig. 2) on the top of the door, the double hinge is prevented from acting, the two leaves are secured together in the same plane, and the door opens as a single one, moving only on the hinges attached to the door-post.

Fig. 1 and 2 are elevations; fig. 3 is a horizontal section through the top of the hinge.

Fig. 1 and 3 are $\frac{1}{4}$ of the real size.

LONDON MECHANICS' INSTITUTION.

MR. FREND'S THIRD LECTURE ON GEOGRAPHY.

REVOLUTION OF THE EARTH ON ITS AXIS—DIFFERENT DEGREES OF VELOCITY FROM THE EQUATOR TO THE POLES—INCORRECTNESS OF MAPS—MERCATOR'S PROJECTION OF THE EARTH—GEOGRAPHICAL ACCOUNT OF AFRICA—ITS CLIMATE, &c.—SLAVE TRADE—IMMENSE DESARTS OF AFRICA—EGYPT—CARTHAGE, &c.

WEDNESDAY, FEBRUARY 22D.

In the last lecture, said Mr. Frend, it was shewn that the earth, as represented by the globe before us, consists of land and water, and that the latter occupies by far the greatest part of its surface. By turning the globe, we shall be enabled to estimate the proportion which the land and water bear to each other, and we shall see that there is a much greater quantity of water in the *Southern* than in the *Northern half-ball.* To form a proper idea of the nature of the earth, we must conceive this globe to be situated at its centre, and that rays proceed from it to every part of the earth's surface. These rays will coincide with the various points which are depicted on the globe; the principal difference being, that this globe is only 36 inches in diameter, while the diameter of the earth is nearly 8000 miles. Now, if the globe be turned round at such a rate, that 24 hours would be occupied by one revolution, it must be evident, that its motion would be so slow as to be scarcely perceptible; but with the earth itself the case is very different, for as it is nearly 24,000 miles in circumference, and performs its diurnal revolution in 24 hours, any point of the equator must move at the rate of 1000 miles an hour.

Let us now consider the effect of this rapid revolution; and here we must remember, that the various parts of the earth's surface move with different degrees of velocity, according to their different situations between the equator and the poles. In this part, for instance, continued the Lecturer (pointing to that portion of the southern hemisphere which lies at 60° from the equator), the surface of the earth moves at the rate of only 500 miles an hour, and hence arises a question involving a difficulty for which I am not able to find a satisfactory solution. Mr. Frend here turned the globe, so as to exhibit, in succession, every part of the southern hemisphere, and pointed out the very small proportion which the land bears to the water in this half of the globe. Water may indeed be considered as occupying nearly the whole of the southern hemisphere, and as the *water* can be moved with a touch, though the land is solid and immovable, the question is, what is the effect produced by the motion of this vast mass of waters, considering that it moves with a velocity of 1000 miles an hour in one part, and only 500 in another? That some great effect results from these different degrees of velocity, which, in fact, continually decrease, according to the distance from the equator, there can be no doubt; and a variety of motions and currents must be produced, which, continued the Lecturer, I must confess I cannot at present perfectly comprehend; and the difficulty is how to represent these currents on the surface of a globe like this, so as to convey a correct idea of their nature. I have considered whether it may be possible by any human contrivance to produce an imitation of these currents on the globe, and it has appeared to me possible to place two rims round the globe where the tropics are situated, and to introduce between these rims a fluid of such a consistency, that it would adhere to the globe when at rest, and yet be moved when the globe was put in rapid revolution, so as to exhibit a motion corresponding with that of the water on the surface of the earth itself. What effect might be produced by such an experiment, supposing that it could be performed, I will not undertake to determine, but it appears to me, that the motion of the fluid must differ in different parts of the imaginary globe. I have been led to these remarks by considering that here is an immense sea agitated by the winds, by various currents, and by the motion of the earth, and that with all our knowledge, we shall perhaps never be able to discover the causes or the effects of all these complicated motions, otherwise than by attributing them to the Great First Cause from which the whole Creation proceeded.

We have now to consider what the globe before us is capable of effecting, and what it cannot accomplish. We know that it cannot represent the earth as it actually is, for it cannot exhibit the immense mountains on its surface, nor can it convey a proper idea of such rivers as our Thames; for what is a mile, or a few miles, when reduced to the scale of such a globe as this? But the globe can furnish us with a proper notion of the relative situation and extent of all the places on its surface. Let us now look at the representation of the globe on *a plane*, and we shall see that if the globe itself is inadequate to give a correct view of the earth, this is still more so. Mr. Frend here directed the attention of the Members to a map of the world, which was exhibited on the diagram board, and observed, that as each of the half-balls were here compressed upon a plane surface, the form of the different parts was very much distorted; yet to those who are not in possession of a globe, a map of this kind is very useful, as it gives a general idea of the relative situation of the various countries, though their distances are necessarily incorrect. A map of the world, on Mercator's projection, was also referred to by the lecturer, who observed that this was still more distorted than the other; for the poles of the earth, which are mere points, are here extended through the whole breadth of the map; yet this projection of the globe is found of considerable utility in some instances.

Having thus given a general idea of the globe, and having divided the land into two great islands, the one comprehending Europe, Asia and Africa, and the other North and South America, we may proceed to notice its various portions more particularly, and shall therefore direct the attention of the audience to that large part of the greatest of these two islands, called AFRICA. Mr. Frend here pointed out Africa on the globe, observing, that it comprehends a vast tract of land, for the most part situated between the tropics; for though Africa extends to the torrid and the two temperate zones, very small portions of it reach the latter, and almost the whole of this vast region is contained within the torrid zone. This country then must possess some peculiar characters, derived from its situation on the globe, and the first of these is *intense heat;* the second, a great *deficiency of water.* If we look at America, we shall find the country intersected by immense rivers, some of them 3,000 miles in length, diverging into different streams 1,000 miles long; but this is not the case with Africa, so great a difference exists between two countries, separated only by the Atlantic.

Mr. Frend proceeded to trace the coast of Africa on the globe, commencing with the southern extremity, at the promontory called the Cape of Good Hope, and proceeding along the western shore, which is bounded by the Atlantic ocean, till he arrived at the narrow channel called the Straits of Gibraltar. Beyond this point the inland sea called the Mediterranean forms the northern boundary of Africa, which terminates at the celebrated Isthmus of Suez, alluded to in a former Lecture. The western boundary is the Red Sea, so well known in history, and the name of which affords a singular instance of the perversion of language. Its proper name is the *Idumean Sea,* from Idumea, or the land of Edom; but, be- [illegible] signified [illegible], it [illegible] name of [illegible].

The western coast brings us to another narrow channel, called the Straits of Babelmandel, through which we pass into the Indian Ocean, and thence along the southern coast of Africa till we again arrive at the Cape of Good Hope.

To give a complete description of this immense continent would require much more time than can be devoted to it in this Lecture; but our first enquiry should be directed to the state in which we here find our fellow creature, MAN. In the southern parts we shall find him like ourselves, as these parts are occupied by own settlers; but the interior of the country, which has hitherto been but little explored, is inhabited by people of a different colour from ourselves; for they happen to be *black,* while we happen to be *white.* Upon this fact a remarkably fine argument has been built—an argument, said the Lecturer, of which I must confess myself unable to discover the force, viz. *that the black gentlemen are inferior to the white gentlemen.* Now if we should chance to discover a *black university* in the unexplored regions of Africa, perhaps we should find one of their *theses* to be, that the blacks are the superior, and the whites the inferior part of the creation. Of the interior of the country, however, we know but little; but we know that a traffic in human flesh was carried on, even two or three thousand years ago, between the interior of Africa and the countries of Asia.

The Europeans improved upon this system, and to fill up the vacancies occasioned by their murders in America, contrived, by means of their vessels, to transplant the poor blacks from Africa, to cultivate the soil in the West-Indian plantations. This horrible traffic was encouraged by Englishmen, who, at one period, were greater traders in human flesh than any other Europeans; and [illegible] continued till within a few years, when the Legislature, to its immortal honour, abolished the Slave-trade. (*applause.*) The Lecturer was aware that at the present moment a great question, connected with this subject, was in agitation, but though he abhorred slavery, and had every feeling of humanity for the poor blacks, his feelings were more deeply interested for those of his own colour, nor could he consent to any measure which, by too much precipitation, might lead to the murder of the whites.

The northern parts of Africa are inhabited by a peculiar race of people, who conquered the country about the year 700, and have kept possession of it ever since. It is a remarkable circumstance, that from the period almost when this tract of country was conquered by the Romans, it was inhabited by Christians, and that at the present time scarcely a Christian is to be found in it. The reason of this was, that the Christians became so quarrelsome, and disputed so much about their different modes of faith, that they became greater enemies to themselves than to their real enemies, and were extirpated by the vast flood of Mahommedans that poured in upon them.

The southern coasts of Africa are colonized by ourselves; and the Hottentots, who are the natives of this part of the country, are a different race from the inhabitants of the central parts. Among the settlers at the Cape of Good Hope and its vicinity, there is a very extraordinary people, who devote themselves to the task of instructing the natives in the useful arts, and rendering them humane, honest, industrious and sober. Their intention is to bring them over to their own religious opinions; but no one can quarrel with the great object which they are pursuing by such means. Their principle is to love one another, and to love all mankind, without any distinction on account of religion, politics, or sects; and if they wish to persuade others to adopt their views in religious matters; they do not endeavour to effect this object by the exercise of envy, hatred, malice, or any species of uncharitableness.

Having thus spoken of the inhabitants of Africa, and stated that one of its local peculiarities is deficiency of water, it may be mentioned that another characteristic of Africa is the immense desarts of sand which are found in this torrid region. These desart regions the inhabitants traverse on camels, and pursue their long marches to Mecca, and to the newly-discovered countries of Houssain and Timbuctoo, without meeting with the slightest signs of vegetation, except upon a very few isolated spots. It has been supposed, from the existence of the Mountains of the Moon, as they are denominated, that some inland lakes are to be found in the central parts of Africa, but it is in vain to speculate upon a subject respecting which we have no certain means of information.

It is a remarkable circumstance connected with the history of the sable inhabitants of Africa, that within the last few years, degraded as they are, they have ventured to meet the British in arms, and have even defeated them. If they are able to do this, they must be capable of better things; and it is a very favourable symptom, that one of their kings, hearing that the European monarchs dwell in palaces, has determined to have a palace built on the European plan. Now my opinion is, continued the Lecturer, that as luxury is favourable to the cultivation of the arts, it is not so bad a thing as some people represent it; and I hope that what with *teaching* the blacks in one direction, and *fighting* with them in another, we shall ultimately succeed in effecting their civilization. (*Laughter.*) Africa produces many valuable articles of commerce; such as ivory, precious woods, gold, &c., and perhaps at some future time a trade may be carried on with its inhabitants, more valuable than our commerce with the East Indies.

Mr. Frend now adverted to that country of Africa called Egypt, which affords an exception to the general scarcity of water in this continent, being abundantly watered by the celebrated river Nile, which empties itself into the Mediterranean, and of which so many fruitless attempts have been made to discover the source. Egypt, three or four thousand years ago, was the cradle of the arts and sciences; and its inhabitants were then as extraordinary for their proficiency in intellectual knowledge, as they are now wretched for want of it. In this country geometry may be said to have originated, and this science arose from the periodical overflow of the Nile, which rendered it necessary to have an exact mode of measuring the lands which were inundated. The cultivated parts of the country are limited to the vicinity of the Nile; for within a few miles on the one side are sandy deserts, and on the other a rocky soil, extending to the Red Sea. The fertility of Egypt might be easily restored, by merely clearing out and restoring the numerous canals with which it was anciently intersected; and if England had kept possession of this country, and a portion of the wealth of London had been devoted to this object, it might soon have been accomplished. But, unfortunately, the Turks are now the masters of Egypt, and we know perfectly well what kind of improvement is to be expected under such dominion as theirs.

The Lecturer next alluded to the remarkable superstitions of the Egyptians, their construction of images of extraordinary size, made of blocks of granite, some of which are deposited in the British Museum; their worship of the Bull and other living animals, and their subjugation by the son of Cyrus, who carried destruction into the country, and destroyed the images wherever he came. Egypt was, in fact, a country of images, and such was the veneration of its inhabitants for the objects of their worship, that the king witnessed the slaughter of his sons and his nobles without changing countenance, but uttered a deep groan when the sword was plunged into the bull. Egypt was successively conquered by the Persians, —by Alexander, who founded the city of Alexandria,—by the Romans,—by the Saracens,—and finally by the Mamelukes, who were themselves slaves, and who verified the prediction that Egypt should become the most debased of all countries—the *slave of slaves*.

This country exhibits a striking instance of the extraordinary changes to which nations are subject. Egypt, now so humbled and degraded, was once the seat of arts, science, and literature, and its fate affords a lesson for us all, and excites us to encourage that spirit of eagerness for acquiring knowledge, and also for communicating it, which is the best safeguard against the occurrence of a similar catastrophe. The priests of Egypt kept their knowledge to themselves, or veiled it in hieroglyphics; for they knew that men who have knowledge always have power; but we may congratulate ourselves on living in an age and a country where an opposite principle prevails, and where we should betray our most valuable privilege, if we failed to communicate the knowledge we have acquired.

Mr. Frend then observed, that he could not quit the subject without noticing the Carthagenians, who inhabited another portion of the continent of Africa. Carthage, as a trading town, bore much the same relation to the rest of the world as London does now. It has been stated, that the Carthagenians sailed round Africa, and though this fact has been doubted, it derives some confirmation from one little circumstance connected with the voyage; for it is said, that the people observed that their *shadows* pointed towards the south in one part of their voyage, whereas in their own country, they were directed towards the north. While Carthage flourished, Rome arose, and, acting upon false principles, conceived the idea of governing all the world by iron. Carthage, as a commercial country, and acting upon the principle, that it was the intention of the Creator that we should all assist each other, became an object of hatred to the Romans, who at last succeeded in conquering the country, and not only destroyed it, but, by the destruction of its writings, destroyed its character also.

Thus have Egypt, once celebrated for the Arts and Sciences, and Carthage, once renowned for Commerce, sunk from their elevation, and for a period of 3000 years, have made hardly any advances in knowledge, while other parts of the globe, from the operation of various causes, have been continually improving; and it is indeed a matter of astonishment, that nation after nation should succeed in any country for so many ages, without any improvement in the intellectual condition of the people.

Having thus gone through the principal points connected with Africa, Mr. Frend observed that, as a Geographical Class was established in the Institution, he would advise the pupils to learn by the eye, and to observe particularly the situation of the various countries on the surface of the globe. He would recommend, for instance, that a few of them should select half a dozen places, and that each should be bound to give some little information respecting the places thus selected. By continuing this plan, they would, in a short time, acquire much valuable information; and with this recommendation to the Geographical Students, Mr. Frend begged to conclude his present lecture.

*** From the length of the Quarterly Report of the Committee of Managers, the Proceedings of the Quarterly Meeting, &c. we are compelled to defer the report of Mr. Tatum's First Lecture on Electricity till next week.

LECTURES FOR NEXT WEEK.

Wednesday, March 8th, Mr. Frend's Fourth Lecture on Geography.

Friday, March 10th, Mr. Tatum's Third Lecture on Electricity.

LONDON MECHANICS' INSTITUTION.

BALLOT

For the Election of a President, Four Vice-Presidents, a Treasurer, and Fifteen Committee-Men.

TUESDAY, FEBRUARY 28TH, 1826

Agreeably to the Rules and Regulations of the Institution, the Ballot for the Election of the above Officers took place this evening, at the Lecture-room in Southampton Buildings, and we were happy to observe the increased activity that prevailed among the Members, in the exercise of one of their most important privileges; for the number who ballotted on this occasion, was more than twice as great as the number who gave their votes at the Election which took place at the same period last year. The Chair was taken at Six o'Clock, by Robert M'William, Esq., immediately after which the following Members were nominated as Scrutineers:—

Mr. John James Cope, *Surveyor*, 11, Great Smith Street, Westminster;

Mr. James Wylie, *Oil and Colourman*, 150, Drury Lane; and

Mr. Thomas Palmer, *Secretary* to the London Friendly Institution of Mechanics, 126, Newgate Street.

The same arrangements were adopted for receiving the Balloting Lists, and checking the names of the Members, as upon former occasions; and at half-past nine o'clock precisely, the Ballot was closed, and the Scrutineers retired to the Committee-room to cast up the numbers.

On their return to the Lecture-room, the Chairman announced the names of all the Candidates, according to the List given in our last week's publication, with the numbers ballotted by each, and declared the majority of votes to have fallen on the following gentlemen:—

FOR PRESIDENT.

George Birkbeck, M.D.	214

FOR VICE-PRESIDENTS.

Robert M'William, Esq.	214
Dr. Gilchrist	186
John Martineau, Esq.	166
Professor Millington	163

FOR TREASURER.

John Key, Esq. *Alderman*	198

FOR COMMITTEE.

(*Candidates of the Working Class.*)

Mr. W. Webster	137
W. Abeling	124
P. Christie	118
P. Thompson	115
J. Chant	114
J. J. Hackett	113
R. Torey	104
J. L. Whitaker	89
J. Wood	89
J. Nicholls	86
H. Roberts	85

(*Candidates not of the Working Class.*)

Mr. J. F. Blake	135
C. Lane	123
R. Taylor	117
A. Pritchard	96

It is provided by the Rules and Regulations, that at least Two-thirds of the Committee-Men shall be chosen from the working classes, in order to insure to that class of society, for whose especial benefit the Institution was established, a preponderance in conducting its affairs; and the result of the present Election affords a practical proof, that the Members have it in their power to increase this majority; for, in this instance, Eleven out of the Fifteen successful Candidates were selected from the working classes.

NINTH QUARTERLY GENERAL MEETING OF THE MEMBERS OF THE LONDON MECHANICS' INSTITUTION.

THE Members of this Institution held their Ninth Quarterly General Meeting on Wednesday evening last, on which occasion the Theatre exhibited a very numerous attendance. At eight o'clock precisely, the Chair was taken by JOHN MARTINEAU, Esq., one of the Vice Presidents, who was supported by Dr. GILCHRIST, ROBERT M'WILLIAM, Esq., WILLIAM ELLIS, Esq., one of the Auditors, Mr. TOOKE, the Solicitor to the Institution, and Mr. FREND.

The CHAIRMAN requested the attention of the Members to the Minutes of the Quarterly General Meeting in December last, which were accordingly read by Mr. CHRISTIE, the Secretary, and confirmed unanimously.

The Secretary then read the following Report of the Proceedings of the Committee of Managers during the last Quarter, which was heard by the Meeting with the greatest attention, and, in many parts, elicited the warm applause of the Members:—

NINTH QUARTERLY REPORT OF THE COMMITTEE OF MANAGERS OF THE LONDON MECHANICS' INSTITUTION.

In compliance with the Rules and Regulations, the Committee of Managers now submit an abstract of their proceedings during the Quarter just terminated. In thus referring to the past, they feel peculiar satisfaction on account of the rapidity with which scientific information, and useful knowledge of every description are extending by means of institutions of this nature through every part of the kingdom: pervading especially those classes of society which have been hitherto deprived of such advantages. And whilst rejoicing in the formation of many valuable institutions, they view with no small gratification the prominent station which this Institution, the great stimulus and example, still continues to occupy amongst these important establishments.

From the following detail of the financial transactions of the past quarter, it will be observed that a considerable portion of the Expenditure, as in several former Reports, has been incurred by outfittings, such as preparing different parts of the premises, and appropriating them to the various purposes of the Institution; and the Disbursements of the Quarter, therefore, exceed what may in future be considered the regular current expenses. At the same time it must be observed, that much yet remains to be done in the outfitting department.

GENERAL CASH ACCOUNT.

	£.	s.	d.
Balance in the Bankers' hands at the commencement of the Quarter	183	2	1
Paid Bankers during the Quarter	535	12	4
Carried forward	718	14	5

Brought forward	£718	14	5
Disbursed during the same period	619	15	6
Leaving a balance at the Bankers, of	98	18	11
In the hands of the Secretary for occasional expenses	10	0	0
Total	£108	18	11

Of the above sum of £535 12*s.* 4*d.* paid to the Bankers, 388*l.* 10*s.* has been received in Subscriptions from Members:—£5 5*s.* from the Irish Evangelical Society, for the use of the Theatre:—£16. from Mr. Moss, for Old Building Materials,—and £105, in Donations.

The Donations consist of £100, presented by the Rev. Robert Fellowes, reported to the Members at the last Quarterly Meeting, but not included in the Quarter Accounts; and £5, presented by Dr. Watson, Teacher of the Deaf and Dumb Asylum, Kent Road.

After particularizing the various items included in the Amount of Disbursements during the Quarter, the Report proceeded in the following terms:—

Your Committee have now, on behalf of the Institution, to acknowledge their obligations to the following gentlemen, who have presented books during the quarter:—

LIST OF BOOKS PRESENTED DURING THE QUARTER.

OUTLINES of Phrenology, 1—Newton's Arithmetic, 2—Oberon, a Mask, and Orestes, a Tragedy, 1—Lipscombe's History of Canine Madness, 1—Minutes of Evidence on the Slave Trade, 1—Instructions for the Drill; by Russell, 1—Sinclair, ou La Victoire des Sciences et des Arts; par Madame De Genlis, 1—The Dangers of the Country, 1—Marryatt's Art of Healing, 1—Traité des Metaux et des Minéraux, 1.	11
(Presented by Mr. Pratt.)	
The First Principles of Algebra,	1
(Presented by Mr. Downes.)	
Philosophical Essays,	2
(Presented by Mr. R. Clarke.)	
Annals of Public Economy, 1—Method of Essaying and Classing Mineral Substances, 1.	2
(Presented by Mr. S. E. Ash.)	
Letters of Junius,	1
(Presented by a Member.)	
Swan's British Architect, 1—Wyld's Practical Surveyor, 1.	2
(Presented by Mr. Partridge.)	
Inquiry into the Manners, &c. in England, 1—Thompson's Evidences of Revealed Religion, 1—Bentley's Poems, 1.	3
(Presented by Mr. Coredon.)	
Botanical Lectures; by a Lady,	1
(Presented by Mr. Hardwicke.)	
Keith's Introduction to Geography, 1—Ramsay's Poems, 1.	2
(Presented by Mr. Livermore.)	
Nicholson's Journal of Natural Philosophy; the 28th volume,	1
(Presented by Mr. D. Jackson.)	
Soulavie's Memoirs of Louis the Sixteenth, 3—Beauties of Shakspeare, 1.	4
(Presented by Mr. Crawford.)	
Rohault's Natural Philosophy,	2
(Presented by Mr. P. Price.)	
Oriental Herald,	7
(Presented by Mr. Buckingham.)	
Rasselas, a Tale, 1—Love of Fame, 1—The Lover and Reader, 1.	3
(Presented by Mr. Ellstup.)	
Lucan's Pharsalia, 1—Belisarius, 1.	2
(Presented by Mr. C. Tuely.)	
A Walk through Switzerland,	1
(Presented by Mr. S. Robinson.)	
Antiquities of Greece; by Lambert Bos, 1—Two Volumes of a Novel, by Miss Edgworth, 2	3
(Presented by Mr. Couldry.)	
Gulliver's Travels, 1—Homer's Odyssey, 1—Worsley's Account of the Government of France, 1—Volumes of Travels, 3.	6
(Presented by Mr. E. Bacon.)	
John Bull Magazine,	1
(Presented by Mr. H. C. Cooper.)	
Dusalés on the Pronunciation of the French Language, 1—Clare's Youths' Introduction to Trade and Business, 1—Number of the Edinburgh Review, 1.	3
(Presented by Mr. J. Mackenzie.)	
Winterbotham's History of America,	4
(Presented by Mr. R. Nicholls.)	
Voltaire's Philosophical Dictionary; by Holmes,	1
(Presented by M. J. L. Whitaker.)	
Las Casas' Journal,	4
(Presented by Dr. Gilchrist.)	
Kelly's Elements of Book-keeping,	1
(Presented by Mr. J. Bowles.)	
Griffin's Chemical Recreations,	1
(Presented by Mr. Griffin.)	
The Craftsman, 6—Analysis of Bolingbroke's Works, 1	7
(Presented by Mr. Baddeley.)	
Barlow on Magnetic Attraction,	1
(Presented by Mr. Binfield.)	
Rohault's Natural Philosophy,	2
(Presented by Mr. Howes.)	

Vicar of Wakefield, 1—Tuti's Elements of Calculation, 2—Tom Jones, 4.	7
(Presented by T. Young, jun.)	
Millar's Chemistry,	1
(Presented by Mr. Simpson.)	
Crutwell on the Currency,	1
(Presented by the Author.)	
Enfield's Scientific Amusements,	1
(Presented by Mr. Fayerman.)	
Newton's Universal Arithmetic,	1
(Presented by B. Bevan, Esq.)	
Murray's History of France, 1—Pope's Essay on Man, 1—Beauties of Shakspeare, 1.	3
(Presented by Mr. Newcombe.)	
Account of the Coronation of James the Second, &c. &c., 1—Ditto of George the Fourth, 1—A General Description of France, 1.	3
(Presented by Mr. Charles Collar.)	
Price's British Carpenter. 1,—Newton's Universal Arithmetic, 1—Antiquities of London, 1.	3
(Presented by Mr. W. Morton.)	
Voyages and Travels, 1—Taylor's Annals of Health and Longevity, 1—Economy of Human Life, 1—Essay on Man, 1—Cooke's British Topography, 3.	7
(Presented by Mr. W. Davies.)	
History of the Triumvirates of Rome,	1
(Presented by Mr. Stratton.)	
Evans's Sketch of the Denominations of the Christian World, 1—Tale of a Tub, 1.	2
(Presented by Mr. Holmes.)	
Accum's Analytical Mineralogy,	2
(Presented by Mr. T. L. Thomson.)	
Total Volumes	111

In addition to the above donations of Books, the Committee have received a Collection of Minerals, presented by John Taylor, Esq.—Several Volcanic Specimens, by John Reed, Esq., and several specimens of Minerals, by Mr. Charles Collar—A small inflammable Air Balloon, by Mr. Watkins—A Ruby, by Mr. S. E. Ash—Four pieces of Mica, by Mr. King, and the Cranium of a Cat, by Mr. Hammond.

In compliance with the suggestions of several of the Members, your Committe took into consideration the propriety of extending the time allowed for reading the books taken out from the Library, and being of opinion that it would be a great accommodation to the Members, they resolved that a fortnight should be allowed for reading an 8vo. or any smaller volume; three weeks for a 4to., and four weeks for a folio.

Your Committee, anxious to afford every facility to Members inclined to use the books in your valuable library, have printed a Catalogue, which has been so arranged as to shew, at one view, all the works in your possession, which treat on each branch of knowledge.

In relation to the Library, it may be further observed, that it contains 2300 Volumes (exclusive of periodicals), of which about 160 are constantly retained for reference; but the latter are likewise used in the Reading-room, when they are not in circulation.

Agreeably to the Rules and Orders, your Committee have next to report, that 401 new Members have enrolled themselves during the Quarter; that 621 have ceased to pay their Subscriptions during the same period, and that the total number of Members at the close of the Quarter's accounts was 1522. It will be observed that the present number of Members is less than the number last reported; but your Committee trust that the present unfavourable state of trade will not be of long continuance, and that many of the Members now in arrears, probably from that cause, will soon be enabled to resume their payments to the Institution.

Besides opening the Apparatus Room, and Laboratory for the inspection of the Members at stated times, the Committee, in order to encourage the improvement and cheap manufacture of Philosophical Instruments, have made arrangements for affording to any Member who applies in writing, an opportunity of more minutely inspecting any piece of apparatus for the purpose of taking its dimensions, or making the requisite drawings.

Your Committee have next to claim your attention to the subject of Lectures. They have to acknowledge their obligations to Mr. Cooper, Mr. Gowring, Mr. Tatum, Mr. Lane, and Mr. Frend, for their valuable services in this important department. This subject, however, is already so completely before the Members, that the Committee feel it unnecessary to say more than to announce that arrangements have been made for Mr. Wallis to commence a Course of Astronomical Lectures on Wednesday, the 22d instant.

During the past Quarter the progress of the Pupils in the different Elementary Schools has been very satisfactory, and their attention to the respective branches of study in which they have been engaged, is deserving of great commendation.

Mr. DOWNES reports, that many of the Members who entered the Mathematical Class at its commencement, are now acquainted with Plane Trigonometry and Mensuration, that some of them have entered upon Conic Sections; and that those who had entered the Class later, had also made considerable progress.

Mr. COLLINS reports, that the progress of the Pupils in the Arithmetical School continues undiminished, and that he cannot speak too highly of their attention and orderly conduct.

Mr. DAVY reports that the progress of the pupils in the Drawing class is fully equal to his expectations.

Several Members of the Committee, who have visited the different Schools, speak most favourably of the present state of all the classes, satisfactorily confirming the preceding Reports of the Teachers.

All the Members who had applied for admission into the French Class, prior to the 5th of January, the day on which the School was opened, have been admitted, and this Class will be succeeded by another, about the beginning of May next, into which those Members who make application up to that time, will likewise be admitted.

Unfortunately for the members composing the Geographical Class they were, through the severe illness of Mr. REYNOLDS, deprived of his instructions, after their second meeting. With the assistance of the Secretary, however, they have since resumed their studies, which they continue to pursue with considerable assiduity and success.

On the 26th of January last, an English Grammar Class commenced their studies, under the direction of Mr. PRESTON, one of the Members of your Committee of Managers, who has kindly offered his services gratuitously for their instruction.

In addition to the Schools already announced, your Committee have to inform the Members that a School, for Instruction in Writing, will be opened in a few weeks, under the direction of Mr. Collins, jun., who has kindly offered his services for six months gratuitously for that purpose.

Your Committee take this opportunity of reminding the Members of the Two Prizes, of Ten Pounds each, to be continued for Five successive Years, which the REV. ROBERT FELLOWES has established, to be competed for by Members of the London Mechanics' Institution: the one to be given to the Member who executes the best Model of any new or improved Machine, and the other for the best Essay on any of the Mechanical Powers. The Prizes will be adjudged by the President and Professors of the Institution for the time being; and those for the present year must be delivered to the Secretary on or before the 15th day of November next, as the Prizes will be presented to the successful Candidates on the 2d day of December following, being the Anniversary of the Establishment of the Institution.

The following conditions must be observed by the Candidates for these Prizes; viz.

1. The Candidates must be actual Mechanics, and must have been Members of the Institution at least twelve months before they deliver in their Models or Essays.

2. Each Model or Essay must be distinguished by a private mark, and accompanied by a sealed Letter, containing the name and address of the Candidate, and distinguished by a corresponding private mark.

3. None of the Letters to be opened, except those of the successful Candidates, and the others to be returned unopened, with the different Models or Essays to their respective owners, according to their respective works.

4. The model of the successful Candidate to be exhibited to the Members on the 2d of December, and to remain at the Institution till the Quarterly General Meeting in the following March, when it will be again exhibited to the Members, and afterwards returned to the Candidate.

In conclusion, your Committee as well as yourselves, have had much reason to deplore the protracted indisposition of our worthy PRESIDENT, and they more especially regret his absence from the present Meeting; but they have, on the other hand, the gratification of now announcing his convalescence, and their anticipation of being soon again cheered by his presence as usual, and aided by his powerful co-operation in the management of the affairs of this great Institution.

Several passages in the above Report were received with decided marks of approbation, and at its conclusion, it was hailed with unanimous plaudits.

The Report of the Committee having been unanimously received, Mr. **Ellis** stepped forward and read the Report of the Auditors on the state of the Society's Finances for the preceding six months, which corresponded with the General Cash Account above stated. The Report of the Auditors also adverted to the examination of the Building Committee's Accounts, by which it appeared, that the total expense of building the new Theatre of the Institution amounted to £4,841 4s. 10d., of which sum £3,700 had been borrowed of the President, Dr. **Birkbeck**, and £1,141 4s. 10d. had been paid from the funds of the Institution. The Report further observed, that a few trifling errors had crept into the Building Committee's accounts, but they were such as occasioned no loss to the Institution; and it was a matter of surprise to the Auditors, not that a few mistakes had occurred, but that, in an account so voluminous and complicated, the errors had been so few in number, and so trivial in amount.

Mr. **Christie** next read the report of the Scrutineers at the Ballot which had taken place on the preceding evening for the Election of Officers, and announced the names of the successful Candidates.

The Meeting then proceeded to take into consideration the propositions which had been made, during the Quarter, for altering the Rules and Orders of the Institution.

The first of these propositions related to the 70th and 75th sections of the Rules, which, by an obvious oversight, state, that the Half-yearly Ballot for the Election of Officers shall take place on the first Tuesdays in March and September, and be reported to the General Meetings on the first Wednesdays.

Mr. **Jones** observed, that the necessity for correcting this error was so self-evident, that no argument was required to enforce it. The intention of the Rules undoubtedly was, that the Ballot should always take place on the Evening before the General Meeting, and he therefore proposed to substitute for the words "the first Tuesdays in March and September," the words "the Tuesdays before the Quarterly General Meetings in March and September."

This motion was regularly seconded, and unanimously adopted by the meeting.

Mr. **Frend** moved the next resolution, which was for the purpose of making some alteration in the 22d article. This regulation states, that "every Member, on paying his subscription, shall receive from the Secretary a copy of the Rules and Orders;" and, as it now stands, would entitle each quarterly Member to receive a Book of the Rules four times a year. The alteration was to introduce the words, "upon paying the sum of sixpence," after the words "Rules and Orders."

A **Member** suggested that it was not the intention of the framers of the Rules that a Book should be given every time the quarterly subscription was received; and he thought that the Members should receive a copy of the Rules gratis on joining the Institution, and pay for any copies they might afterwards require.

After some further discussion, Dr. **Gilchrist** observed, that this was one of the first instances that had occurred for effecting an economical object without injury to the Members of the Institution. One Gentleman had stated that the first copy of the Rules should be furnished gratis; but in case of any alteration in the Rules, it would be equally necessary to present other copies. Another Member had intimated that sixpence was more than the printing of the Books would cost; but if this were the case, the surplus would go towards the diminution of other expenses. Sixpence was almost nothing to an individual Member; but 1500 sixpences coming in, would be something to the Institution. He recollected hearing a preacher in the North observe to his hearers at the close of his sermon, "If I were to give every one of you sixpence, you would each be only sixpence the richer; but if each of you were to give me sixpence——." The conclusion of the Doctor's appropriate anecdote was drowned in the loud laughter of the Members, and the Resolution was unanimously carried.

The third propostion was to the effect that 60 Committee-men should be appointed to conduct the affairs of the Institution, instead of 30, as stated in the 4th section of the Rules.

No Member appearing disposed to move this Resolution, the meeting was about to proceed to other business, when a Member rose and said, "I beg leave to move it;" and another

Member said, "I beg leave to second it."

Mr. **Cope** observed, that perhaps the mover and seconder would have the goodness to assign their reasons for supporting this proposition. For his own part, he had served on the Committee for 12 months, and never saw any want of attendance which required such an addition to their number.

The **Mover** declared himself unacquainted with the business, and unacquainted with the motion. (*Laughter.*) He did not understand that such a motion was to be brought forward; but his idea was, the more managers the better.

Mr. **Frend** observed, that the appointment of 60 Committee-men instead of 30, was the best possible method that could be submitted, to throw the whole Institution into confusion; and Dr. Gilchrist, after a few other remarks, reminded the Members, that though there was a proverb which stated that "in a multitude of counsellors there is safety," there was also another saying, that "too many cooks spoil the broth." (*Loud laughter.*)

The Resolution was then put by the **Chairman**, and negatived by an overwhelming majority.

The Secretary then read the following Letter from Dr. **Birkbeck**, addressed to the Members of the Institution:—

"50, *Broad-street, Feb.* 28, 1826.

"**Gentlemen**,—I regret exceedingly that I am again prevented by the state of my health, from occupying my official situation, at the approaching Quarterly General Meeting of the London Mechanics' Institution. In the hands of your Vice Presidents, I know the business will be most successfully conducted: my regret you will therefore understand, arises from the loss of that gratification, which the admirable proceedings of these Meetings have always afforded.

"Having spoken in several verbal communications to you of the long expected Lectures on Mechanics by Professor Millington, as being likely soon to be delivered; as being indeed in all respects fixed, excepting as to the precise day of their commencement; it becomes necessary, for me, individually, to state to you briefly the cause, alike of my confidence and your disappointment. Relying upon Mr. Millington's warm interest in the prosperity of this Institution, and upon the very unequivocal promise with which he concluded his very excellent course of lectures in Monkwell Street, I took it for granted that when the Theatre was quite finished, and the Committee called upon him for his assistance, he would have been instantly at their service. I was not then, nor indeed until about ten days since, aware of the engrossing extent of his engagements in a great mining concern in Cornwall; and I did not contemplate the possibility of his being so situated, as to make it impossible for him to remain near us long enough to complete a course of lectures of sufficient length. He laments, no less sincerely than you can do, the occurrence of this unexpected difficulty; and will I am confident, so soon as it is in his power, be delighted to perform for you the scientific service which you have so anxiously anticipated. In order to have occupied this space, I should have been most happy to have begun the Lectures on the Structure and Functions of the Human Body, formerly promised; but unfortunately, I am now, and shall for some time, remain deficient, both in the bodily and mental energy required for that undertaking. I am glad, however, to find that when the valuable Lectures now in progress are terminated, the interesting Astronomical Lectures of Mr. Wallis will succeed: and that a Gentleman, well qualified for the task, whose name and arrangements will soon be announced to you, has kindly consented to deliver a course of Lectures on the Theory of Mechanics, in place of those, of which, for reasons just stated, we have been unexpectedly disappointed.

With every good wish, I remain,
Your sincere and faithful friend,
GEORGE BIRKBECK."

The worthy **President**'s Letter was heard with the most respectful attention, and received with the loudest applause.

Mr. **Gloyn** then addressed the Meeting, and observed that there were two subjects which he expected would have been alluded to in the Report of the Committee, one of which was, the Honorary Members who had been admitted into the Institution agreeable to a late regulation; and the other, an advertisement which the Committee had inserted in the Newspapers for letting the Theatre; in which they had stated, among other things, that they were ready to let it to *preachers* and *teachers* on Sundays. Mr. Gloyn here read the greater part of the advertisement in a sarcastic tone, and concluded by intimating that a List of the Honorary Members ought to have been laid before the Meeting, and that the Society ought to have been consulted before such an advertisement was inserted.

Mr. M'William intimated that the names of the Honorary Members had been stated so often, in laying their donations, &c. before the Society, that he thought it unnecessary to say any more on the first question. With respect to the second, he hardly knew whether the speaker intended his remarks as a censure on the Committee, or whether he only inquired for information. If the former, the Committee were ready to receive any censure they might have deserved; but if the latter, he begged to state that the letting of the Theatre was the very basis on which it was built; for the Committe, in taking the premises, never intended to leave the expense of building the Theatre as a burden on the shoulders of the Members, without letting it for the Meeting of any individuals, who conducted themselves with decorum, whose appearance was reputable, and whose objects were not contrary to the established religion of the country. The Committee reserved to the Members the exclusive right of occupying the Theatre whenever the purposes of the Institution required it; and they had already begun to reap some benefit from the advertisement in question.

A discussion of considerable length followed, in which Dr. Gilchrist, Mr. Tijou, Mr. C. Lane, Mr. Ethell, Mr. Frend, and other Members took a part. Some objections were made to the manner in which the advertisement was drawn up, but these objections were answered, on the part of the Committee, to the general satisfaction of the Meeting.

Mr. Gloyn terminated the discussion by a speech, in which his principal objection to the advertisement appeared to be, the letting of the Theatre on Sundays for the promulgation of *religious doctrines*. In the course of his remarks, which were evidently intended to prove that if the Theatre were let to the *preachers of Christianity*, it ought also to be open to *its opponents*, he alluded to the observations we thought it our duty to make, on a recent occasion, relative to the dinner in commemoration of Tom Paine's birth, (vide page 255,) and after stating that the "Mechanics' Register" might be considered as *the authorized organ of the Institution*, he attributed *our expressions* to the Committee of Managers, and was proceeding to read the paragraph alluded to, when he was interrupted by Dr. Gilchrist and Mr. R. Taylor, who protested against the reading of any anonymous article. The latter gentleman denied that the Institution had any "*authorized organ*" in the Public Press, and observed that the Committee ought not to be made responsible for the remarks of others. *

The Chairman decided that the paragraph ought not to be read to the Meeting, and the subject was then dismissed.

After some further suggestions from the Members, on different subjects, the Thanks of the Meeting were unanimously voted to Messrs. Frend, Tatum, Cooper, Lane, and Gowring, for their excellent Lectures delivered to the Members during the past Quarter: to Dr. Birkbeck, and the Vice-Presidents, for their indefatigable exertions in behalf of the Institution: to the retiring Committee, for their valuable services; and to the Secretary and the Librarian, for their strict attention to the duties of their offices.

Suitable acknowledgments were returned by Dr. Gilchrist, Mr. Frend, Mr. Lane, Mr. Tijou, (on behalf of the retiring Committee), Mr. Christie, &c. and the Thanks of the Meeting were finally voted, by acclamation, to the Chairman, for his gentlemanly and impartial conduct in the Chair.

Mr. Martineau, in returning thanks for the honor conferred upon him, expressed his anxiety to promote the interests of the Institution upon all occasions, and observed, that, from what he had witnessed that evening, if all public meetings were constituted like the present, the office of Chairman would become a sinecure.

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* To the very correct observations of Mr. Taylor, we beg to add our unqualified denial of Mr. Gloyn's assumption, that "*the* Mechanics' Register *is the authorized organ of the Institution*." That we have uniformly advocated the cause of the London Mechanics' Institution, and have lent our humble endeavours to the promotion of its welfare, by regularly recording its proceedings, our readers are perfectly aware; but we repeat that the Committee of the Institution have never possessed nor assumed any control over our pages, nor have they interfered, either directly or indirectly, with the conduct of our publication. With respect to the article alluded to by the speaker, we can assure him that it was entirely dictated and written by ourselves, and that we alone are responsible for every syllable it contains. Editor.

The Meeting was then adjourned, and the Members separated soon after 10 o'clock.

DR. BLACK'S EXPERIMENT ON HEAT.

To the Editor of the Mechanics' Register.

SIR,—In the fifth paragraph of my answer to a Correspondent on the subject of Latent Heat, I perceive that I have, inadvertently, committed an error of such a nature as to render the statement not only false, but absurd. Corrected, the clause will read thus: "Mix 1lb of Ice at 32° with 1lb of water at 172°, and, as soon as the Ice is melted, if the experiment be expeditiously performed, the resulting temperature will be only 32°."

An insertion of this correction will oblige,

Yours, respectfully,
S. P.

EFFECTS OF MILDEW ON CANVASS.

It is well-known by those concerned in the manufacture and use of canvass, how deleterious is the effect of mildew upon it. Exposure to the influence of damp, in a store-house, cellar, or the hold of a vessel, and more especially to continued moisture, as in that part of a tent which is in immediate contact with the ground, or when sails have been rolled up, or stowed away wet, in the hurry of a storm, &c., produces mouldiness, dark-coloured spots and rottenness. This Dr. Greville has considered to be caused (in part, at least,) by a minute cryptogamic plant, of which he traced the subglobose and transparent sporules, though the filaments were indistinct, adding, "from the nature of the whole tribe of these plants, I do not think the present one would have been produced except the canvass had been previously in a damp state." The prevention of mildew and rot in canvass has for more than half a century occupied a considerable portion of attention; but considerable disadvantages have attended the processes hitherto devised. Mr. Sanderson, of Leith, professes to be in possession of a method, (antiseptic) of which decisive and highly satisfactory trials have been made, and which is recommended "as completely efficient under all ordinary circumstances."

QUERIES.

No. 53.

WHAT is the real cause (or causes) of the report of a gun or cannon?

S. E. ASH.

No. 54.

I shall feel obliged by any of your Correspondents informing me, through the medium of your valuable publication, the quickest method of calculating any given number of yards, quarters, or eighths of cloth at any given price, as I understand there are very expeditious modes of doing it?

W. ASHLEY,
MEMBER OF THE L. M. I.

No. 55.

SIR,—Can any of your readers inform me, through the medium of your excellent work, of what is the best and most substantial gummy substance used to fasten tin-foil on jars, and the small round pieces of the same metal on glass plates used in luminous experiments?

W. L——D.

ANSWERS TO QUERIES.

QUERY No. 45. Vol. II. Page 142.

METHOD OF STUFFING AND PRESERVING ANIMALS.

[*continued from page 302.*]

BIRDS.

To the Editor of the Mechanics' Register.

Your correspondent must divide the feathers of the belly right and left, pull out the down which covers the belly, make an incision into the skin from the *sternum* or breast-bone until beyond the middle of the belly, raise the skin on one side, and separate it from the muscles, with a knife approaching as near as possible to the wings; this done, he is to put a little powdered cotton on the skin and flesh, that the feathers may not stick to them; he then pushes the thighs within the body of the skin, and cuts them off at the joint. By the help of a knife and the fingers, he is to detach the skin as far as the rump, which he cuts off, and continues to separate the skin from the two sides, and the wings from the trunk.

Having skinned the neck, he is to proceed with the head, as I described for quadrupeds. He then pushes the wings out, divides the bones at the second joint, and taking away the flesh, restores them to their places; he likewise does the same with the thigh bones.

All this being done, he is to introduce into the neck, the preservative alternately with the flax, and do the same along the back as far as the rump, stuffing it to nearly one-third of its thickness, that the iron work may be placed on a thick layer of flax. He is then to prepare four wires, the proportions of which are equal to the size of the bird. The centre or body piece ought to be nearly twice the length of the bird; he bends it at nearly a third of its length, in the form of an oval, twists it two turns, then passes the shortest end into the oval, and raises it against the longer end, so as to form a ring at the end or beyond the oval, big enough to receive the two wires of the legs; he twists it a second time, uniting it strongly to the long end, which is straight and pointed, then rubbing it with oil, he enters it in the neck, already stuffed with chopped flax, and thrusts it through the scull; the oval of the wire ought to be in the middle of the body. The wires of the claws are to be straight and pointed; he passes them through the soles of the feet, (having previously, by the aid of a brass awl, made a passage through the claw and bone of the thigh), into the little ring above the oval; he twists them together and curves them within; he then fastens them with a thread to each side of the oval.

It still remains to form the fourth wire, called the tail bearer: he is to take a piece of iron wire, to form an oval with it by twisting the ends two or three times, in such a manner that, after being twisted, the two ends form a fork, and the oval is nearly a third of the length of the bird's body; the two teeth of the fork must be pointed with a file, and near enough together to enter the rump; their ends will be concealed under the great feathers of the tail, and the oval in the body of the bird.

All these wires being placed, he is to anoint right and left, and especially the rump; and in proportion as the preservative is placed, he is to furnish the part with chopped flax. He then sews the body up, and introduces the enamel eyes. He now places the bird on a board by means of the two-leg wires, and gives the bird its proper attitude.

Rye. TYRO.

QUERY No 3. Vol. III. Page 13.

DYEING KID GLOVES, &c.

With *orchill* you may doubtless give kid leather all the shades of blue and lilac. The more it is diluted with water, the lighter will be the blue: with an alkali, (say potash,) you may add even so much to its depth of colour and with an acid, (say *sulphuric*,) you may obtain any shade of lilac.

I should imagine a good ink, (formulæ for which may be found in the pages of this work,) would give an excellent black dye.

Kid leather after dyeing would most probably require pressure or gumming to give it the usual polish. F. C.

QUERY No. 5. Vol. III. page 14.

TO DARKEN AND POLISH MAHOGANY.

Mahogany may be darkened to any degree by *Lime-water*.

Where a fine polish is of no moment, raw linseed oil rubbed over the wood, gives it a pleasing smoothness, and fills up the grain very well.

But the finest polish I ever saw, was produced by a varnish, which was evidently made with copal. Several coats were laid on the furniture, and when thoroughly dry, the last was rubbed with pumice stone and water, until quite smooth; another and another layer were then applied, and similarly treated, rubbing the whole over at last, with a flannel having a little wax upon it.

I repeat, its polish was superior to any thing I ever saw beside. F. C.

TO CORRESPONDENTS.

The favours of several of our friends are necessarily postponed, in consequence of the press of matter which has occupied our attention this week, but will appear in our next Number. From the same cause, we are again obliged to defer our answers to other Correspondents.

THE LONDON
MECHANICS' REGISTER.

> "He that would make a real progress in knowledge, must dedicate his age as well as youth, the latter growth as well as the first fruits, at the altar of truth."
>
> BERKELEY.

No. 77.] SATURDAY, MARCH 11, 1826. [Price 3d.

MR. BRUNEL'S PATENT APPARATUS FOR OBTAINING POWERS FROM CERTAIN FLUIDS.

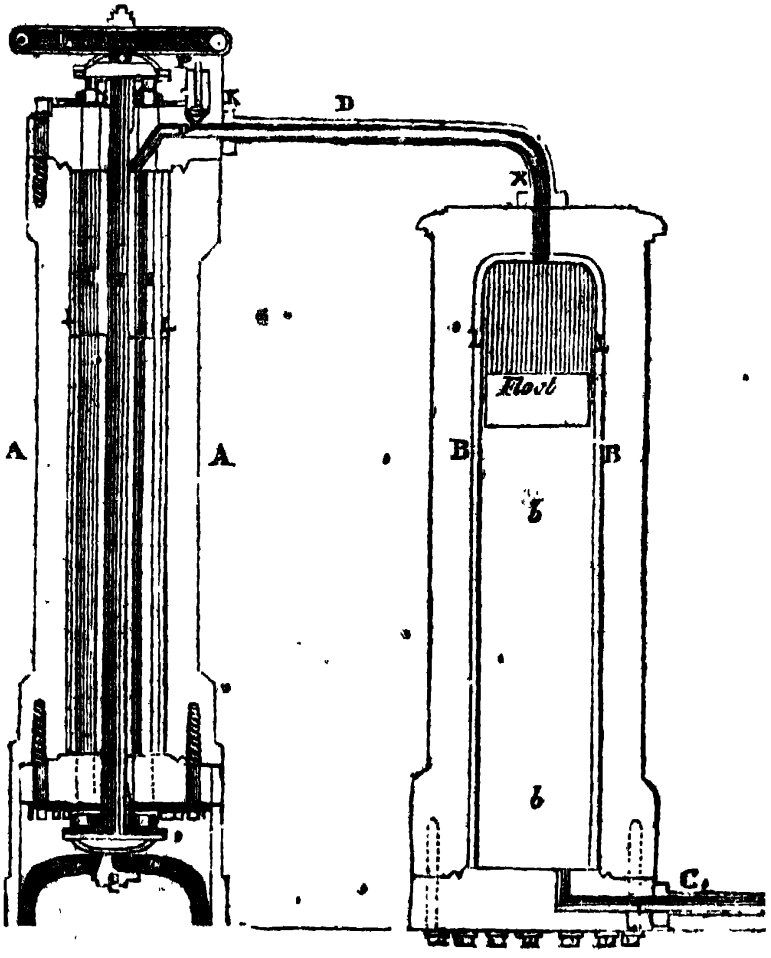


Fig. 1.

Fig. 3.

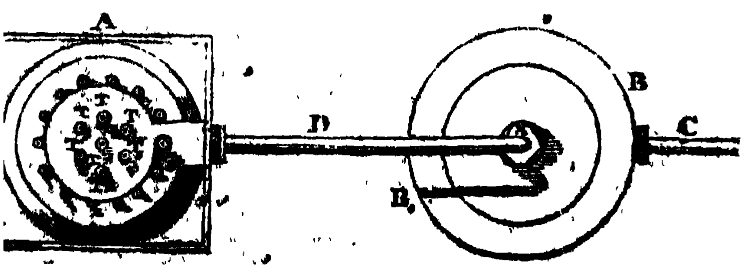


Fig. 2.

Fig .4.

MR. BRUNEL'S PATENT APPARATUS, FOR APPLYING THE FLUIDS RESULTING FROM THE CONDENSATION OF CERTAIN GASES TO THE PRODUCTION OF MECHANICAL POWER.

MR. BRUNEL'S invention of certain mechanical arrangements, for obtaining powers from certain fluids, and for applying the same to various mechanical purposes, is described by the Patentee, in his specification, in the following terms:—

"The fluids or liquids, from which the powers in question are to be obtained, are those which result from the condensation of certain gases, which, at the ordinary pressure and temperature of the atmosphere always remain in the *gaseous* or *aëriform state*. There are several gases which come under this description, some of which are treated upon by Mr. Faraday, in the papers read before the Royal Society of London, in 1823. I give the preference to *carbonic acid gas*. This gas, at the temperature of freezing water, requires a pressure of about 30 atmospheres to condense and retain it in a liquid state. It may be obtained by decomposing any carbonate by the action of any of the common acids. The mode of obtaining the liquid from the gas is by forming the gas under a gasometer, and condensing it afterwards, by means of a condensing pump, into a vessel, and continuing the operation until it passes to the liquid state. Having explained the way of obtaining the gas and the liquid resulting from it, I shall proceed now to describe the various parts of the mechanical arrangements intended for obtaining the power, and applying it to various mechanical purposes.

Fig. 5.

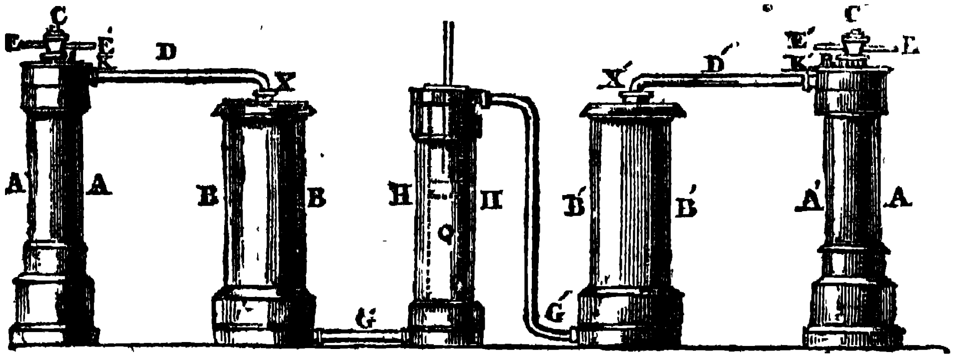
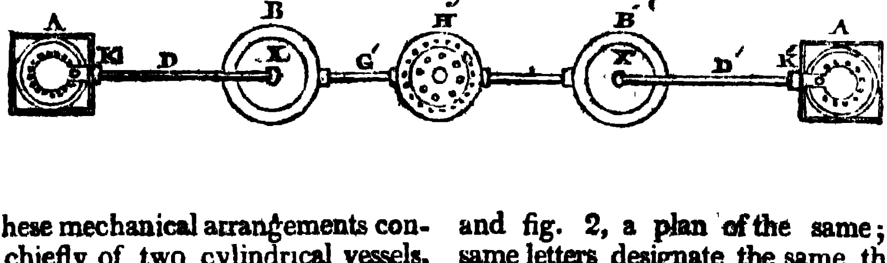


Fig. 6



These mechanical arrangements consist chiefly of two cylindrical vessels, denominated receivers, into which the liquid has been previously forced, by the action of the pump. One receiver is shown at A A, and the other, A′ A′, figs. 5 and 6. The fig. 1, A A (*vide* Frontispiece) is an enlarged section, and fig. 2, a plan of the same; the same letters designate the same things in the different figures. The communication from the pump to the receiver is through the orifice, O, fig. 1, which can be stopped at pleasure by the plug or stop-cock, P, figs. 1 and 2. When the receiver has been charged with the liquid and closed, a pipe, D, is applied to it at K, figs. 1 and 2, and connected at X with a vessel, denominated the expansion vessel, B B, figs. 3 and 4: L L, figs. 1 and 3, is a lining of wood, or other non-conductor of heat, to prevent the absorption which would otherwise be occasioned by the thick substance of the metal. This expansion vessel is connected through a pipe, G, figs. 3, 5, and 6, to a working cylinder represented at H, figs. 5 and 6. The figs. 5 and 6 represent two receivers, A A and A′ A′, connected with the working cylinder, H, through the intermediate expansion vessels, B B, B′ B′. The figs. 3 and 4, B B, represent an expansion vessel on an enlarged scale. These vessels contain oil, or any other suitable fluid, shown at *b b*, fig. 3, as a medium between the gas and the piston, Q, fig. 5. Before explaining the action of these parts, I shall describe how the power is obtained in the receiver. The receiver consists, as represented in fig. 1, of a strong metal cylinder, in the interior of which there are one or more thin metal vessels. Tubes are most convenient, as represented at T T T, figs. 1 and 2; the joints of these tubes, through the top and bottom of the receiver are made perfectly tight; this I do by packings rather than by soldering. The use of these tubes is to apply alternately heat and cold to the liquid contained in the receiver, without altering very sensibly the temperature of the cylinder. The operation of heating and cooling through the thin tubes, T T T, figs. 1 and 2, may be effected with warm water, steam, or any other heating medium, and cold water, or any other cooling medium. For this purpose the tubes, T T T, fig. 1, are united at the top and bottom by a chamber and cock, C C C C. By the opening of these cocks with the pipes, E E, hot and cold water, which I propose here to use, may be alternately let in and forced through by means of pumps. The cocks may be worked as steam-cocks are worked in some steam-engines. Now, if the hot water, say at 120°, is let in through the tubes of the receiver, A A, figs. 5 and 6, and cold water at the same time through the receiver, A′ A′, the liquid in the first receiver will operate with a force of about 90 atmospheres, while the liquid in the receiver, A′ A′, will only exert a force of 40 or 50 atmospheres. The difference between these two pressures will therefore be the acting power, which, through the medium of the oil, will operate upon the piston, Q, in the cylinder, H, fig. 5. It is easy to comprehend that, by letting hot water through the receiver, A′ A′, and cold water at the same time through the opposite one, A A, a re-action will take place, which will produce in the working cylinder, H, an alternate movement of the piston, Q, applicable by the rod, I, to various mechanical purposes, as required. It is to be observed that the use of the gasometer and of the forcing pumps is simply for obtaining the gas, and for charging the receivers with the liquid. When the receiver is once charged, and has been closed with the stop-cock, P, fig. 1 and 2, the gasometer and forcing pumps are to be disconnected from the receiver by unscrewing the pipe, D, at the screw joint, K, figs. 1 and 2. The same pipe may, however, be used as the means of connecting the receiver with the expansion vessel, or another suitable pipe may be substituted for it at the orifice, O, fig. 1, and the other extremity adapted to the expansion vessel at X and X′, figs. 3, 4, 5, and 6. I have intentionally avoided adopting two distinct pipes to the receiver, viz. one for the pumps, and another for connecting the receiver with the expansion vessel, because, if there were two orifices, two stop-cocks would be necessary, which should be avoided. It is obvious that there is no difficulty in connecting the forcing pump with both receivers, as the small pipes used for that purpose may be made to reach either. In the mechanical arrangements for obtaining powers from the liquids when formed, I claim, as my invention, the application of the receiver, as it is before described, the essential part of which is the internal application of the vessel or tubes destined to convey the heat and cold. Their form and the manner they are applied render them capable of resisting the intense external pressure of the liquid, and yet admit of their being made so thin as to allow of the rapid and complete transmission of heat and cold through them to and from the liquid; and I further claim the arrangements by which the receivers, acting in opposition to each other, produce, without any aid of intermediate valves, an alternative action, which may be applied to various mechanical purposes.

LONDON MECHANICS' INSTITUTION.

MR. TATUM'S FIRST LECTURE ON ELECTRICITY.

ACCIDENTAL DISCOVERY OF ELECTRICITY, MAGNETISM, AND GALVANISM—HISTORICAL SKETCH—ELECTRICAL ATTRACTION—ELECTRICAL AFFINITY—REDUNDANCY AND DEFICIENCY OF THE ELECTRIC FLUID—GOLD LEAF ELECTROMETER—ELECTRICITY EVOLVED BY METALS—ZINC—DE LUC'S ELECTRICAL COLUMN, &c.

FRIDAY, FEBRUARY 24TH.

MR. TATUM introduced his illustrations of the science of Electricity, by observing that every votary of science who had paid any attention to electricity, magnetism, or galvanism, must have observed that their original discovery was attributable to accidental circumstances. Electricity, for instance, was the offspring of accident, and arose from the attraction which *amber*, when rubbed, was observed to possess for light substances. Magnetism was discovered by the accidental observation that iron was attracted by the loadstone, and galvanism, or voltaic electricity, owed its origin to a similar cause, and was discovered in consequence of the violent muscular action produced in the limbs of a frog, which one of the pupils of Galvani accidentally touched with his scalpel, while drawing sparks from the electrical machine. But though the first discovery of all these branches of science was owing to accident, a knowledge of the intimate connection which, in a variety of circumstances, is found to subsist between them, was the result of scientific research, to which is to be attributed the discovery, that both electricity and galvanism are capable of communicating magnetic properties to ferruginous substances.

Many of the most important phenomena of nature depend on the science of electricity, and it is our business, upon this occasion, to trace its progress from the earliest experiments by which its existence was demonstrated, to its agency in producing the thunder and lightning which roll and flash through the vault of heaven. Mr Tatum here gave a comprehensive sketch of the rise and progress of the science of electricity, from the time of Thales, the Milesian, to the more recent discoveries of Dr. Gilbert, Mr. Hawksbee, Mr. Grey, Dr. Watson, and other philosophers, including the discovery of the *Leyden Jar*, &c.; but as we have already given a full account of this part of the subject in our report of Mr. Tatum's former lectures on electricity (Vol. I. p. 5.) and of Mr. Lewthwaite's lectures on the same science (Vol. I. p. 403.) we beg to refer our readers to those reports for further information.

In the course of his historical sketch Mr. Tatum alluded to the principle of *electrical repulsion*, said to have been discovered by Mr Hawksbee, but the Lecturer denied the existence of such a principle, and stated that all electrical phenomena might be accounted for on the principle of *attraction* alone. He also spoke of the important discovery of the Leyden jar in the year 1745, by Von Kliest, since which period electricians had been enabled to treasure up the electric fluid and perform their experiments on a much more magnificent scale than before.

Mr. Tatum then proceeded to exhibit those experiments which first gave rise to the science, by exciting a piece of *amber*, and shewing that it was capable of attracting light substances. An excited glass tube and other substances were also shewn to possess a similar property, and the lecturer observed that he thought the phenomena of electricity might be explained on the principle of *affinity*. The Members are aware of the principle upon which the operation of chemical tests, or re-agents depends, viz. that if we add to any compound a substance possessing a greater *attraction* or *affinity* for one of its constituents, than was possessed by the substance with which it was previously united, the substance added will decompose the compound, and form a new compound by entering into combination with that constituent. So it is with electricity; for when *glass* is excited by friction, it abstracts, by its superior affinity, a portion of electricity from the silk with which it is excited, and becoming in a state of *redundancy*, it attracts light bodies in order to give off its *redundant* quantity of electricity. The contrary effect takes place when *amber* or *sealing-wax* is excited, for in this case, the substance on which they are rubbed abstracts a portion of their electricity, and leaves them in a *deficient*, instead of a *redundant* state.

After some further observations on *vitreous* and *resinous*, or *positive* and *negative* electricity, in the course of which he remarked that what is called *positive* and *negative* electricity is merely a *redundancy* or *deficiency* of the same electric fluid, Mr. Tatum observed, that, generally speaking, *resinous* bodies are the best electrics, as their surfaces are not so liable as *vitreous* ones to attract moisture from the atmosphere. Glass, for instance, will attract moisture sooner than sealing-wax.

The Lecturer next performed a variety of experiments with the *gold-leaf electrometer*; an instrument to which we have frequently had occasion to allude, and which it is therefore unnecessary to describe in this place.* To this delicate instrument several substances were successively presented, such as excited *glass* and *sealing-wax*; cones of *sulphur*, with handles both of wood and of glass, &c. all of which caused the gold leaves to diverge with *positive* or *negative* electricity, according as the different substances were in a *redundant* or *deficient* state. A plate of *zinc*, attached to a wooden handle, was also excited, and shewn to be capable of attracting light substances, though not insulated, as well of exhibiting signs of electricity, when presented to the cap of the electrometer. From this circumstance, Mr. Tatum inferred that *metals* are *electrics*; and in this respect he differed in opinion from many electricians, who considered the metals as *non-electrics*. He trusted, however, that he should be able to prove that different metals produce different kinds of electricity; but when he spoke of different electricities, he wished it to be clearly understood that he meant only a *redundant* or *deficient* state of the electric fluid, or what was called by electricians *plus* and *minus*.

Mr. Tatum then exhibited the effect of De Luc's electrical column, consisting of a series of plates of *zinc* and *silver*, placed alternately, and shewed that when the *zinc* end of the instrument was presented to the electrometer, signs of *positive* electricity were elicited, but that when the silver end of of the column was applied, the electricity exhibited was *negative*.

Having thus shewn, concluded the Lecture that *metals*, as well as *vitreous* and *resinous* bodies are electrics, and are capable of producing signs both of *positive* and *negative* electricity, even when not insulated, but merely held by a wooden handle, I shall proceed, in the next lecture, to examine the phenomena of electricity by means of more powerful apparatus. The present lecture is merely intended to establish the first principles of the science, and is meant as an introduction to the further developement of its operations.

As we are anxious to avoid unnecessary repetition, our report of the present lecture is more compendious than usual; and we again refer our readers to the account of Mr. Tatum's first lecture on electricity (Vol. I. p. 5.) where they will find most of the experiments more minutely particularized.

MR. TATUM'S SECOND LECTURE ON ELECTRICITY.

VITREOUS, RESINOUS, AND METALLIC ELECTRICITY — ELECTRICAL PHENOMENA, PRODUCED BY ANIMAL SUBSTANCES — SILK, FLANNEL, HUMAN HAIR, &c. — ELECTRICAL EELS — ELECTRICAL MACHINE — PRINCIPLE AND OPERATION OF THE LEYDEN JAR, &c.

FRIDAY, MARCH 3D.

Mr. Tatum, after briefly adverting to the principal subjects of his former lecture, particularly his experiments to prove that *metallic bodies* were not only capable of producing signs of electricity when tried by the electrometer, but also of attracting light substances, proceeded to observe in continuation, that it did not follow, because our forefathers only knew that certain substances possessed electrical properties, that their successors might not, by prosecuting the subject, discover that other bodies were also *electrics;* and he therefore inferred that *metals,* as well as *vitreous* and *resinous* substances ought to be placed in the class of electrical bodies. He had further shewn, not only that it was unnecessary that metals should be insulated, in order to exhibit signs of electricity, but that in the experiment with De Luc's column, it was necessary that it should not be insulated; for when the electrical column was insulated by means of a silken string, no effect was produced on the electrometer; but when the insulation was destroyed, by applying the hand to the column, the gold leaves immediately diverged, and signs of *positive* or *negative* electricity were produced, according as the *zinc* or *silver* end of the column was presented to the electrometer.

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* The following extract from Dr. Ure's Chemical Dictionary will clearly explain the manner in which the gold-leaf electrometer indicates the kind of electricity possessed by any substance presented to it:—"To know the species of electricity noticed, it is merely necessary to communicate beforehand, to the slips of gold leaf, a known electricity either from excited *glass* or *sealing-wax*. If they be *divergent* with the former, then the approach of a body *similarly* electrified, will *augment the divergence*, but that of one *oppositely* electrified will cause them to *collapse*."

But there are other substances, besides those already mentioned, which ought to be considered as *electrics.* Some authors deny that *animal substances* are *electrics,* though, a few pages afterwards, they describe the electrical effect produced by the friction of a cat's back. How this inconsistency was to be reconciled the Lecturer could not tell; but he thought that the cat's back must be left out of the question, or it must be admitted that an animal substance may be an *electric.*

Silk, the product of a worm—flannel—fur—human hair, &c. are also animal substances, and are all capable of exhibiting electrical phenomena. Sparks of electricity have been seen by ladies when combing their hair in the dark, and the Lecturer remembered an instance of the production of electricity from flannel, which occurred in the family of a gentleman who is a donor, both to this and the Spitalfields Mechanics' Institution. His lady had put her child to bed, with a piece of warm flannel over its stomach, when upon drawing off the flannel, a sudden light appeared. Alarmed at this phenomenon, she imagined that it prognosticated evil, and portended the death of the infant; but her husband assured her that there was no reason for apprehension, and that it was merely a natural effect, which he had no doubt Mr. Tatum could readily explain. It was, in fact, an electrical phenomenon, analagous to that which is sometimes produced by drawing a silk stocking from off a worsted one. The Lecturer had seen a silk stocking so powerfully excited by this means, that it appeared as full as though the leg remained in it, or as if it were inflated with wind. Mr. Tatum here exhibited the skin of a cat, from which, when the animal was alive, he had repeatedly drawn sparks which he could both see and hear, by passing his hand over the cat's back in the dark. Other instances might be adduced, but, perhaps, the most striking was the powerful electric effect produced by a species of eels, about 5 feet in length, mentioned in Humboldt's Travels. The Lecturer then read an extract from the Quarterly Review, detailing the destructive effect of these electrical eels, which actually killed some of the horses and mules by the powerful electric shocks they communicated (Vide Vol. I. page 6). All these circumstances afford proofs that animal substances are *electrics;* and the latter example proves that some animals are not only capable of producing electrical effects after they are dead, but of giving strong electric shocks when living.

In the experiments introduced in the last lecture electrical phenomena were produced without the aid of the machine; but if we excite a stick of sealing-wax, or a glass tube, these substances are to all intents and purposes small electrical machines. We cannot, however, without great inconvenience, perform any powerful experiments by such means. In order to understand the nature of electrical experiments, it is necessary to remember the principles laid down in the former lecture, and to bear in mind, that no signs of electricity are produced, except while the electric fluid is passing from one point to another. Friction is not indispensably necessary to excite bodies, but it is usually resorted to, because it increases their affinity for the electric fluid.

Mr. Tatum then minutely explained the construction and operation of the *electrical machine;* the cylinder and cushion; the *positive* and *negative* conductors; the necessity of preserving, by means of a chain, the connection between the machine and the earth, which is the grand reservoir of the electric fluid; and many other particulars which our readers will find detailed in our first Volume (page 402), with a correct engraving of the electrical machine.

The Lecturer next exemplified the manner in which the Leyden jar was accidentally discovered, by electrifying some water contained in a glass vessel, and rubbing his hand over the exterior of the vessel, while the sparks were passing from the conductor of the machine through the water to its interior surface. In this experiment, his hand represented the *outside*, and the water the *inside coating* of the jar; and it was shewn, that the glass vessel became charged by this means, for a strong spark passed as soon as the discharging rod was applied. If the Lecturer had formed the connection by his hands instead of the discharging rod, he would have experienced a smart shock, and it was by receiving, accidentally, a shock of this kind, while electrifying some water in a drinking glass, that the principle of the Leyden jar was discovered.

A variety of experiments were then introduced to illustrate the nature and operation of the *Leyden jar*, most of which we have already described in our reports of Mr. Tatum's former lectures, and on other occasions. One important point enforced and demonstrated by the Lecturer was, that the jar contains no more electricity after it is charged than it did before, the only difference being, that when the jar is charged, the whole of its electricity is conveyed to the *interior* of the vessel, instead of being equally divided between the exterior and interior surfaces. Thus, if we suppose 100 parts to represent the quantity of electricity contained by a jar in its natural state, 50 of these parts will be on the outside, and 50 on the inside of the vessel, but when it is charged, the 50 parts on the exterior are thrown into the interior, which then contains the whole quantity, or 100 parts. The discharge of the jar restores the equilibrium, by conveying the redundant quantity of electricity to the outside of the vessel. The example here given is that of a jar charged from the *positive* conductor of the machine; but the Lecturer proved, that it may also be charged from the *negative* conductor, in which case, the whole of the fluid is conveyed to the *exterior* of the vessel, and the jar is said to be *negatively* charged.

Another of the principles of the jar elucidated by the Lecturer was the action of the *coatings*, which are only employed for the purpose of conveying the electricity to every part of the interior surface of the glass at once. That the electricity resides in the *glass*, and not in the *coatings*, was demonstrated by charging a jar, furnished with *moveable coatings*. After the jar was charged, these coatings were dextrously removed, and other coatings substituted. The jar was then discharged, in the usual manner, and this experiment decidedly proved the correctness of the Lecturer's assertion.

Mr. Tatum concluded by observing, that he should resume the same subject in his next lecture.

LECTURES FOR NEXT WEEK.

Wednesday, March 15th, Mr. Frend's Fifth Lecture on Geography.

Friday March 17th, Mr. Tatum's Fourth Lecture on Electricity.

INTRODUCTION TO THE STUDY OF BOTANY.

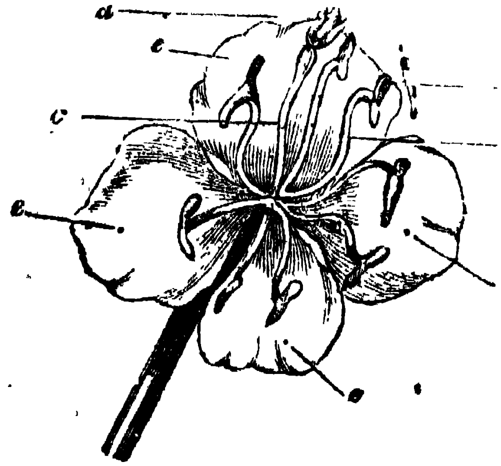
To the Editor of the Mechanics' Register.

1. If your readers turn to Mr. Wheeler's First Lecture on Botany (Vol. I. page 322), they will find that plants, like our own bodies, are covered in every part with a *cuticle* or *epidermis;* that immediately under the cuticle is the *cellular integument*, or *parenchymæ;* that beneath this pulp is the *bark*, and within the bark is found the *wood*. In the Second Lecture (Vol. I. page 342), are described, the *sap vessels* and *sap;* the *root* as consisting of two parts, the *caudex* and *radicula;* and the different kind of *stems* or *stalks*. In the Third Lecture (Vol. I. page 358), is a description of the *leaf* or *folium;* but as the *fulcra* or *props* are not noticed, of which, according to Linnæus, there are seven, we will give a short description of them. 1. *Stipula*, is a kind of leaf, different from the real leaf, situated at the bottom of the *petiole* or leaf-stalk; sometimes placed at the sides, giving a winged appearance, as in the rose. 2. *Bractea*, or floral leaf, is to the *peduncle* (or flower stalk) what the *stipula* is to the leaf stalk, as in the lime tree. 3. *Spina*, or thorn, is composed of wood and bark. 4. *Aculens*, or prickle, consists of bark or cuticle: it is easy to distinguish the thorn from the prickle by stripping the bark, when, if they be the former, they remain; but if the latter, they come away.

5. *Cirrus*, or tendril, whose use is to support those plants which are furnished with it, as in the vine and passion flower. 6. *Glandula*, or gland, is like a little tubercle, discharging a fluid, which has often a very beautiful appearance, as in the moss of the rose *(rosa muscosa)*, and the common sundew *(drosera rotundifolia)*. 7. *Pilus*, or hair, serving as a protection from too great heat and cold, &c.

2. Mr. Wheeler then goes on to describe the seven parts of *fructification*, and it will be necessary before we proceed to the classes, for the student to be well acquainted with them. The figures will enable him more clearly to understand and distinguish the parts in question.

Fig. 1.



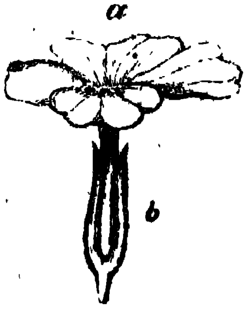


Fig 2

3. *Calyx*, flower cup, or empalement, is that envelope, commonly of a green colour, which encloses the *corolla* or *blossom*, as in fig. 2; *a* is the *corolla*, and *b* the *calyx*. In examining plants, this organ will be found to vary without end; in some flowers it is wanting, as in the crown imperial, tulip, and lily; in others, it is not unfrequently *caducous*; that is, falls off when they blow, as in the poppy; in a large proportion it is *deciduous*, or drops off with them; in many it protects the fructification destitute of corolla; in the greater number it is permanent *(persistens)*; that is, it remains until the fruit is perfected. There are, according to Linnæus, seven species of calyx; the *Perianth*, *Involucrum*, *Amentum*, *Spatha*, *Gluma*, *Calyptra*, and *Volva*, all of which shall be described, when we notice those plants to which they are peculiar.

4. *Corolla*, is that beautiful part called, in common language, the *flower*; the leaves of which it is composed are termed *petals* (fig. 1, *e e e*), and it is said to be *monopetalous* when it consists of only one petal, as in the primrose, the tube part being called *tubus*, and the upper part *limbus* or border; *dipetalous*, when it is composed of two; *tripetalous*, when of three, &c. The leaves of a corolla of more than one petal consist, each, of an inferior part, called the *unguis* or *claw*, and the expansion named *lamina*, or *border*.

5. *Stamen* consists of three parts, the *filament* or *filamentum*, as *b* fig. 1; the *anther* or *anthera*, on the top of the filament, as *a* fig. 1, and the *pollen* or *farina*, a sort of mealy powder contained in the anther.

6. *Pistil* likewise consists of three parts, the *germen*, the *style (c)*, and the *stigma (d)*.

7. *Pericarpium*, or seed vessel, formed from the germen, which enlarges after the flower has dropped off, and protects the seeds until they are ripe, when it bursts. There are seven kinds of pericarp; *Capsula* or capsule, consisting of valves, the number of which is various; *Siliqua* or pod, to be explained when we describe the 15th class, *Tetradynamia*; *Legumen* or legume, as the pericarp of a pea; *Drupa*, a drupe, or stone fruit; *Pomum*, pome, or apple; *Bacca*, or berry; and *Strobilus* or cone, as the Scotch fir.

8. The *seed* and *receptacle* require no explanation.

9. There still remains to consider the

nectary, which is best explained by saying "it is any part in a flower over and above the seven parts of fructification," and generally secreting a sweet fluid. It is situated in the corolla, and sometimes distinct, forming a kind of spur behind the flower, as in the violet.

10. We will now turn our attention to the method of distinguishing plants pursued by Linnæus, and universally adopted. His great division is into *classes*, founded on the number, situation, connection, or comparative height of the *stamens*; these are sub-divided into *orders*; the orders into *genera* and the genera into *species*.

11. The classes are enumerated in Mr. Wheeler's Fourth Lecture (Vol. I. page 392). The first eleven classes are known by the number of stamens; the twelfth and thirteenth have an unlimited number, but the former must have the stamens attached to the calyx or petals, while in the latter they are fixed to the receptacle: the fourteenth and fifteenth are distinguished by the number and length of the stamens: the sixteenth class has the filaments united into one set, whatever may be their number; the seventeenth class has the corollas *papillionaceous*, as the blossom of the pea, or else the filaments united into two sets: the eighteenth has the filaments united into more than two sets: the nineteenth may be distinguished by the anther being united so as to form a tube around the style, and by the compound flowers: the twentieth is known by the stamens being connected to, or growing out of some part of the pistil or germen. The plants belonging to the twenty-first and twenty-second do not bear perfect flowers; for those which are furnished with stamens have no pistils, and are termed *males*, and those which are furnished with pistils have not stamens and are called *females*; but in the former they must be on the same plant, while in the latter they are on different individual plants: the twenty-third includes such plants as produce three different kinds of flowers, namely, some with pistils only, some only with stamens, and others with both, either on the same individual, or on two or three different plants: the twenty-fourth class comprehends all plants in which the flowers are inconspicuous.

12. We will now give a fuller explanation of these classes, describing their orders as we proceed.

CLASS 1. MONANDRIA.

13. The first class is MONANDRIA, distinguished by having *one stamen* in each flower, and contains two orders, viz.

14. *Monogynia*, one pistil, and *Digynia*, two pistils.

The British plants belonging to this class are few, though it contains several very beautiful and valuable foreign plants, as the Cardamoms, Indian arrow-root, ginger, and turmeric. The Hippuris, or mare's-tail, is contained in the first order; it grows in ditches, having only the rudiments of a calyx, no corolla, and only one stamen, whose anther is slightly divided, and a pistil with an awl-shaped stigma (that is, slender, and becoming finer towards the end); these are situated at the base of the leaf; the leaves are *verticillate*, that is, surrounding the stem, and standing out like the spokes of a wheel from the nave.

15. The flowers of this class are few, unattractive, and difficult; and I would advise the student to leave this class until he has gained more experience.

Rye TYRO.

[*To be continued.*]

EFFECTS OF CARBONIC ACID GAS ON THE ATMOSPHERE.

To the Editor of the Mechanics' Register.

SIR,—In No. 67, under the head "Notice to Correspondents," you have declined inserting my reply to Gmo. Henricus's second letter, and you say, "Too much asperity has already been displayed," and so on: now let me assure you, I have neither felt any in this case, nor could I in any similar one. So far, I am sorry my letter was not inserted: but as that correspondent who has had the last hearing states the air to be oftener "deteriorated by excess of oxygen than by fixed air," and that but for lime-kilns, "cities would scarce be habitable," and as these are grossly erroneous notions, I trust you will favour me by inserting some extracts, which, at the same time that they bear out all I have asserted, cannot fail to prove highly instructive to those who have never read the works from which I have selected them,

I remain, Sir,
Your very obedient servant,
F. C.

EXTRACTS FROM SIR H. DAVY'S AGRICULTURAL CHEMISTRY.

Page 210.—"Elastic fluids of different specific gravity have a tendency to equable mixture by a species of attraction, and the different parts of the atmosphere are constantly agitated and blended together by winds or other causes."

Page 211.—The principal consumption of the *carbonic acid* in the atmosphere seems to be in affording nourishment to plants, and some of them appear to be supplied with carbon chiefly from this source." "*Carbonic acid gas* is formed during fermentation, combustion, putrefaction, respiration, and a number of operations taking place upon the surface of the earth, and there is no other process known in nature by which it can be destroyed, but by vegetation."

Page 213.—"If the air" (common air) "be confined, it is found, that in the process of germination, the *oxygen* or a part of it is absorbed: the *azote* remains unaltered; no *carbonic acid* is taken away from the air; on the contrary some is added."

"Seeds are incapable of germinating except when *oxygen* is present."

Page 222.—"So that *carbon* is added to plants from the air, by the process of vegetation in sunshine; and *oxygen* is added to the atmosphere."

"The absorption of *carbonic acid gas*, and the production of *oxygen*, are performed by the leaf; and leaves recently separated from the tree effect the change, when confined in portions of air containing *carbonic acid*, and absorb *carbonic acid*, and produce *oxygen*, even when immersed in water holding *carbonic acid* in solution."

Page 223.—"Plants exposed to light have been found to produce *oxygen gas* in an elastic medium, and in water containing no *carbonic acid gas*; but in quantities much smaller than when *carbonic acid gas* was present. In the dark, no *oxygen gas* is produced by plants, whatever be the elastic medium to which they are exposed; and no *carbonic acid* absorbed. In most cases, on the contrary, *oxygen gas*, if it be present, is absorbed, and *carbonic acid gas* is produced."

Page 224.—"Some persons have supposed, that plants exposed in the free atmosphere to the vicissitudes of sunshine and shade, light and darkness, consume more *oxygen* than they produce; and that their permanent agency upon air is similar to that of animals; and this opinion is espoused by the writer on the subject I have just quoted (Mr. D. Ellis), in his ingenious researches on vegetation. But all experiments brought forward in favour of this idea, and particularly his experiments, have been made under circumstances unfavourable to accuracy of result. The plants have been confined, and supplied with food in an unnatural manner; and the influence of light upon them has been very much diminished by the nature of the media through which it passed."

Pages 226-7 and 8.—Give experiments to *prove*, that "When the leaves of vegetables perform their healthy functions, they tend to purify the atmosphere in the common variations of weather, and change from light to darkness."

Page 228.—"In germination, and at the time of the decay of the leaf, *oxygen* must be absorbed; but when it is is considered how large a part of the surface of the earth is clothed with perennial grasses, and that half of the globe is always exposed to the solar light, it appears by far the most probable opinion, that more *oxygen* is produced than consumed during the process of vegetation; and that it is this circumstance which is the principal cause of the uniformity of the constitution of the atmosphere."

Page 229.—"If every plant, during the progress of its life, makes a very small addition of *oxygen* to the air, and occasions a very small consumption of *carbonic acid*, the effect may be conceived adequate to the wants of nature."

Page 229.—"It may occur as an objection to these views, that if the leaves of plants purify the atmosphere towards the end of autumn, and through the winter, and early in spring, the air in our climates must become impure; the *oxygen* in it diminish, and the *carbonic acid gas* increase, which is not the case; but there is a very satisfactory answer to this objection. The different parts of the atmosphere are constantly mixed together by winds, which when they are strong, move at the rate of from 60 to 100 miles in an hour. In our winter, the south-west gales convey air which has been purified by the vast forests and savannas of South America, and which passing over the ocean, arrives in an uncontaminated state. The storms and tempests which often occur at the beginning and towards the middle of our winter, and which generally blow from the same quarter of the globe, have a salutary influence. By constant agitation and motion, the equilibrium of the constituent parts of the atmosphere is preserved; it is fitted for the purposes of life; and those events which the superstitious formerly referred to the wrath of heaven, or the agency of evil spirits, and in which they saw only disorder and confusion, are demonstrated by science to be ministrations of Divine intelligence, and connected with the order and harmony of our system."

Page 231.—"Many plants that grow upon rocks or soils, containing no *carbonic matter*, can only be supposed to acquire their *charcoal* from the *carbonic acid gas* in the atmosphere; and the leaf may be considered, at the same time, as an organ of absorption, and an organ in which the sap may undergo different chemical changes."

N. B. Dr. Ure, in his Chemistry, bears out all the main points of my opinions. So also does Thomson, in the 4th Volume of his Chemistry, quoting the highest authorities to strengthen his own.

ON THE TIDES OF THE OCEAN IN DIFFERENT LATITUDES.

SIR,—Your worthy and excellent Lecturer, Mr. FREND, seems no way disposed, to use a very common phrase, to make "mountains of mole-hills;" on the contrary, I think he is much inclined to the converse of this notable saying: for in estimating the force of the waters of the southern ocean, he makes no mention of the immense chains of mountains, and coral rocks which there can be no doubt abound in every part of it, and in a greater proportion than the projections of the dry land, for the coral rocks are entirely productions of the post-diluvian world.

From these considerations I submit, though with all deference to Mr. FREND, that the following passage is scarcely modified enough, or that it leads to expectations rather exceeding what the circumstances will justify. "Water may indeed be considered, as occupying nearly the whole of the southern hemisphere, and as the water *can be moved with a touch,* though the land is solid and immovable, the question is, what is the effect produced by the motion of *this vast mass of waters,* considering that it moves with a velocity of 1000 miles an hour in one part, and only 500 in another."

The parts of this passage marked in Italics, would, I apprehend, lead many persons to infer, the southern Atlantic and Pacific Oceans constituted nearly an uninterrupted sheet of water; but the many islands that peep above the surface of this immense expanse, and the new ones which are daily springing up, are evidence, that the mass of waters cannot circulate with that freedom, which it would do, *if* there were *not* a permanently mechanical resistance distributed throughout its whole extent.

And again, Mr. FREND* says, "a variety of motions and currents *must be produced,* which, I must confess, I cannot at present perfectly comprehend; and the difficulty is, how to represent these currents on the surface of a globe like this, so as to convey a correct idea of their nature." Now, I think the questions which present themselves on this occasion, are, first, what currents are actually produced? and, secondly, do any of them describe an entire, or even half a circle of the globe, in any of its latitudes? When these are satisfactorily determined, and if it be afterwards desirable to make hydrographical experiments on a small scale, by way of illustration, I should beg to submit the following contrivance as a good one. Let tubular rings of glass be used, enclosing coloured water or spirits, and mounted with brass apparatus, so as to turn in any direction. This would perhaps show the currents, but I fear it would be an expensive and an ugly appendage to the common globe.

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* I hope this gentleman will pardon the liberty I have taken with his name; but I do assure him, that knowledge is my only aim.

A little further on, the Lecturer continues thus, "What effect might be produced by such an experiment, supposing that it could be performed, I will not undertake to determine; but it appears to me, that the motion of the fluid must differ in different parts of the imaginary globe." Now I candidly confess, Sir, it surprises me to find men of science and learning, mooting such questions as this. I have often thought that the philosophy of fluids, was not half so well understood as that of solids: and this will confirm me in the opinion, if I do not hereafter find that I have misinterpreted the Lecturer's meaning. I presume that the query is whether the motion of the waters arises from a distinct centripetal force (which I think it cannot,) or, whether it is merely influenced by the attraction of the moon and sun: in either case the direct force would be greatly modified by the sinuous structure of the earth's surface. I should think its revolutions are not governed by a distinct centripetal force from that which governs the earth, (or at least in a very slight degree,) for the area which any body describes must be uninterrupted, if that body is to be judged by the laws which regulate the free centripetal forces of the universe, as the planets and their satellites. Now though the fluidity of water might favour the hypothesis, that each of its particles would have a tendency to generate, in some degree a separate centripetal force, in the particular circle in which it was made to revolve—and consequently that the mass of waters would obtain an accelerated motion, increasing in a certain ratio from the equator to the poles; (according to the law of *central* forces, that bodies move faster in small orbits than in large ones;) yet I think it will be found, that this takes place only in a very superficial and irregular manner. For as the waters of the ocean are bedded in the hard unyielding rock, and also invested with an innumerable multitude of perpendicular barriers; and as the areas of those revolutions which the particles of water might otherwise describe (if it be possible to conceive them distinct centripetal forces from the rest of the earth) are nearly filled with the intervening mass of denser land; *it not only results* that the accelerated motion which might have been produced by such a force in the higher latitudes, would be greatly counteracted by the waters coming in contact with the mechanical resistance thus afforded, and so losing the uniformity and co-hesion which constitute an entire body, and on which the freedom and certainty of centripetal forces depends—but it also appears that whatever be the causes of the motions alluded to, the effect of those causes will be much tortured and perverted by the obstructions which the water meets with in the bosom of the ocean.

I have been prompted to say thus much, not from any disrespect for your worthy lecturer, but, sincerely with the desire of being informed myself, and of setting others right on the subject. I have merely attempted to argue on the probabilities within my reach, and am anxious to embrace that opinion which is sustained by the greatest quantity of rational evidence.

And I remain,
Sir, yours, &c.
T. T.

Terra Incognita, March 8th.

FORMULA FOR DETERMINING EASTER.

To the Editor of the Mechanics' Register.

SIR,—I send you the following method for the determination of Easter (which is extracted from *Astronomie Théorique et Pratique, par M. Delambre*), not merely as a matter of curiosity, but as of some utility to those of your readers who have not seen that work. Its insertion will greatly oblige

Your humble servant,
THOMAS TAYLOR.
London Road.

1. Divide the number of the year by 19, and call the remainder a.
2. Divide the same number by 4, and call the remainder b.
3. Divide it also by 7, and call the remainder c.
4. Divide $(19a + M)$ by 30, and call the remainder d.
5. Divide $(2b + 4c + 6d + N)$ by 7, and call the remainder e.
6. For the *Julian* Calendar make $M = 15$, and $N = 6$, constantly.

For the *Gregorian* Calendar,

	M.	N.
From 1582 to 1699	22	3
1700 — 1799	23	3
1800 — 1899	23	4
1900 — 1999	24	5
2000 — 2099	24	5
2100 — 2199	24	6

This rule is general for the *Julian* Calendar; in the *Gregorian*, there are only two exceptions:—

1. If the computation give April 26, substitute the 19th.
2. If it give April 25, substitute the 18th.

7. You will have for Easter-day, either $(22 + d + e)$ of March;
or, $(d + e - 9)$ of April.

Suppose, to exemplify the rule, we find Easter-day for 1826:—

$$\frac{1826}{19} = \frac{19.96 + 2}{19} \ldots a = 2 \qquad\qquad 19a = 38$$

$$\frac{1826}{4} = \frac{4.456 + 2}{4} \ldots b = 2 \qquad\qquad M = 23$$

$$\qquad\qquad N = 4$$

$$\frac{1826}{7} = \frac{7.260 + 6}{7} \ldots c = 6$$

$$\frac{19a + M}{30} = \frac{38 + 23}{30} = \frac{60}{30} = \frac{30.2 + 1}{30} \ldots d = 1$$

$$\frac{2b + 4c + 6d + N}{7} = \frac{4 + 24 + 6 + 4}{7} = \frac{38}{7} = \frac{7.5 + 3}{7} \ldots e = 3.$$

Then, $22 + d + e = 22 + 1 + 3 = 26$ March.

CHEMICAL ACTION OF CYANOGEN ON POTASSIUM.

To the Editor of the Mechanics' Register.

SIR,—I offer no apology for troubling you with this, because I have observed repeated proofs of your anxious wish to afford every facility to your readers, in acquiring information or explanation; the difficulty in which I find myself, and through the means of your useful pages have to request the assistance of some of your able correspondents, arises from Mr. COOPER's remarks, after exhibiting to us the action of *Cyanogen* on *Potassium*. "This experiment," said he, "is somewhat paradoxical, as it might be inferred that *Cyanogen* was a *supporter of com-*

bustion, but this is not the case"—meaning, I presume, that *Cyanogen* not being a supporter, this was not an act of combustion. Immediately afterwards, however, he said—"This compound is analogous to the combination of *chlorine* with *metallic* and other bodies."

The first question I would ask is, Is not the combination of *chlorine* with *potassium* an act of combustion? The only definition of combustion which I now find is, "an intense chemical action, generally accompanied by light and heat," and being aware of the objections to which the theories of Stahl and Lavoisier are liable, as insufficient to account for all the phenomena which occur, I think it must be allowed to be the best which, in the present state of our knowledge, (or rather ignorance) can be given; now to both the above-mentioned cases, this definition applies, and not only are the resulting compounds analogous, but in both instances the same phenomena occur during their combination. Am I then to consider one as an act of combustion, and the other not? And is there any other reason for this, than because *cyanogen* is not *called* a supporter? Mr. Cooper's explanation, does not appear quite satisfactory—"all gaseous bodies" said he, contain light and heat, and perhaps electricity, which are given out when they enter into combination with other bodies."—I thought it was still a question amongst philosophers, whether the light and heat proceeded from the *supporter*, or the *combustible body* itself, and I should be extremely happy to be informed by whom, and by what experiments this difference has been decided. I am aware that in most cases the combination of "gaseous with other bodies," is accompanied by an increase of temperature, but so likewise is the combination *of many other bodies* which exert a chemical action on each other, when the compound which results is of greater specific gravity than the mean gravity of the two, and this I can account for, on Dr. Black's Theory of *Latent Heat*—but this does not decide from which of the two the *caloric* is extricated—with respect to the light, I should also wish some proof, because I believe in some cases two gaseous bodies will unite and form a solid, thus passing from one extreme to the other, without any extrication of light---for instance, the union of *ammoniacal* and *carbonic*, or *muriatic acid gas*.

I am convinced that nothing tends so much to mislead and bewilder the judgment as a too easy acquiescence in speculative and theoretical doctrines: perhaps I may have carried this feeling to an extreme; if so, my plea of justification is the scientific dandyism of the present day.

Your obedient servant,
SCEPTICUS.

OBSERVATIONS ON VARIOUS SUBJECTS.

To the Editor of the Mechanics' Register.

MR. EDITOR,—Your kindness in inserting a former letter of mine in your valuable pages, encourages me to address you a second time, as I am persuaded, that if you observe any thing useful in the present communication, you will make it known to the public, who will then be enabled to exercise their inexorable justice on the following ideas.

I.—PACKET BOATS.

I think it would be advantageous to suspend the cabins of packet-boats on springs, similar to those of carriages; in order to obviate, or at least to diminish, the unpleasant effects which the passengers experience from motion of the sea.

II.—CONVEYANCE OF LETTERS.

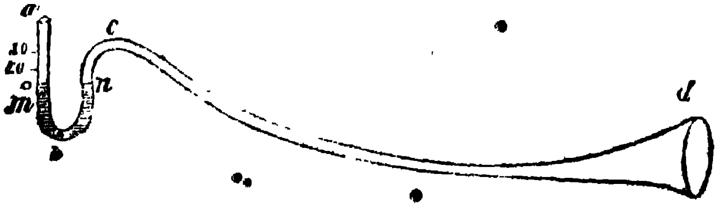
It appears to me, that the conveyance of written communications might be greatly accelerated by inclosing the letters in the interior of bombs, which might be thrown by large mortars.

To put this plan into practice between two places, a line of mortars should be established in the interval; which, being constantly pointed in the same direction, would throw the bombs very nearly upon the same points of the earth: but to avoid all danger, a space might be inclosed more than sufficiently large to receive the bombs, allowing for every deviation they could possibly have. The bomb thrown by the first mortar would also be thrown by the second, by the third, and so on till the letters arrived at their destination. Or perhaps it might be more convenient to take the letter-box from the first bomb, and inclose it immediately in the second, which would be already placed in the second mortar, and so on.

Instead of bombs, Congreve rockets, or the steam-guns, invented by Mr. Perkins, might be employed for this purpose. And if it be true (what at least is credible) that by the latter invention, a bomb may actually be thrown from Dover to Calais, then, by a similar power, the mail might be transported from London to Paris in less than a minute. But without, at present, carrying our ideas quite so far, we will rest content, if we obtain with certainty, by the employment of large mortars (even those which are already in use), a communication so rapid, that we may reckon the time by minutes instead of hours. We may even supersede the use of telegraphs by this method.

III.—MANOMETER, OR INSTRUMENT FOR MEASURING A SHIP'S WAY.

I know not whether the following suggestion is likely to be successful, and must, therefore, leave it to mariners to decide upon its practicability by experience. It appears to me to be possible to ascertain, at least within a trifle, the rate at which a ship sails, by employing a kind of *manometer*, constructed on the principles exhibited in the following figure:—



The part of the manometer, *a b c*, remains in the interior of the ship, and the part *c d* on the exterior in the same direction as the ship's course. If the vessel moves slowly, the mercury contained in the manometer at *m b n*, will rise but little in the branch *a b*; if, on the contrary, the motion of the vessel is very rapid, the elevation of the mercury will be considerable, and will be indicated by the graduated scale of the instrument. The bend of the branch *c d* should not be very sudden.

IV.—EFFECTS OF ZINC IN PRESERVING IRON FROM RUST.

I saw lately, at Rotterdam, two pieces of *iron* of equal dimensions, to one of which, a small plate of *zinc* had been applied; after which, they had been placed in two vessels of equal size, filled with water, where they had remained for a great length of time. The result was, that the piece of iron *without zinc* was covered with a very thick coating of rust, while the other, *with the zinc*, remained in its original

V.—CEMENT FOR BROKEN GLASS.

When in France, I was informed by an old proprietor of the Island of Saint Domingo, that the juice of the acacia (*robinia pseudo-acacia*) was used there for the purpose of cementing glass utensils and broken windows.

VI.—MUSHROOMS.

At Madrid, mushrooms are placed in a vessel of water, into which a piece of silver money is put, which remains white, if the mushrooms are fit to eat, but becomes black if they are poisonous: probably the blackness arises from the deposition of sulphur on the silver.

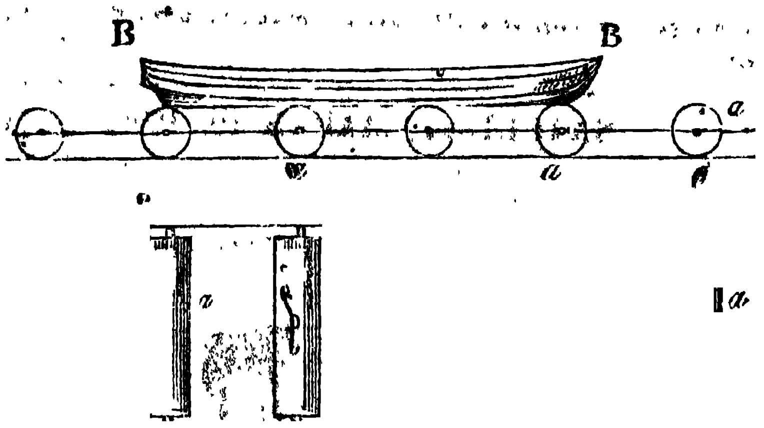
VII.—MODE OF CATCHING WILD GEESE IN PORTUGAL.

In the marshes of the Tagus, in Portugal, wild geese are caught in the following manner. A number of large gourds (*cucurbita*) are thrown upon the waters of the marshes, with which the geese soon become familiar. After this has been done, a number of men, with sacks attached to their girdles, enter the marshes, with their heads introduced into similar gourds, hollowed out and pierced with a few small holes to see through. The geese, feeling no alarm at the appearance of the gourds, remain quiet, while the men approach, and seizing them by the feet deposit them in their sacks beneath the water.

When they have filled their sacks, they return to dry land and prepare for recommencing their operations. The number of geese taken in this manner is almost incredible.

VIII.—PLAN FOR AN IRON ROAD

It appears to me that an iron road might be advantageously constructed in the manner represented in the following figure:



a a a, are cast iron cylinders which revolve on their axes, *c c c c*; on this system of cylinders, passes a kind of boat B B, moved by steam, or drawn by steam engines, placed at intervals along the borders of the road, and furnished with chains to which the boats are fastened. I have no time to enter into further details, and my paper is exhausted.

Your very humble servant,
TAGITANUS.

*** Our correspondent will excuse the omission of two or three of his suggestions, as well as any inadvertent misconception of his meaning that may have occurred in our hasty translation of his MS., which is rather indistinctly written in some parts.—ED.

QUERIES.

No. 56.

WHAT is the best method of making, the safest method of raising, and the most simple apparatus necessary to use with the Electrical Kite?

C. R. I.

No. 57.

THE best mode of cleaning oil-colour paintings?

TO CORRESPONDENTS.

We have received MR. GLOYN's Letter, but we cannot consent to its insertion in our Pages, nor can we waste our time in answering all the futile arguments it contains. If we have misrepresented any part of Mr. G.'s observations, we are sorry for it; but we must be allowed to believe the evidence of our own senses, confirmed as that evidence is by the testimony of many others. If Mr. G. did not say that "the MECHANICS' REGISTER might be considered as the authorized organ of the Institution," what *did* he say?—and for what purpose did he quote the MECHANICS' REGISTER, and attempt to read our remarks at all, except to insinuate that the Committee had something to do with the insertion of the article in question? an inference which, as we have before stated, is totally unfounded in fact. The trifling discrepancy, if it be one, between our report and Mr. G.'s first speech, mentioned in another part of his Letter, is of very little importance, and most of his other remarks, rather confirm than impugn the general accuracy of our account.

D. H. K.'s Answer to a Query is by no means satisfactory.

E. L.'s Query is not exactly adapted to our work.

We beg to express our acknowledgements to TYRO for his first paper on Botany, and shall feel obliged to him to transmit the succeeding ones as regularly as may suit his convenience. Whatever engravings may be necessary to illustrate the subject, we shall be happy to introduce.

The communications of F. S. and L'ami des Sciences are under consideration.

We are obliged to "A regular Subscriber" for his suggestions, but the task he has set us is not a very easy one to accomplish. We can assure him that more than "a little attention" is devoted to the other subject of his letter.

Pierre, M.--L. S., &c. in our next.

THE LONDON

MECHANICS' REGISTER.

> "The improvement of the understanding is for two ends: first, our own increase of knowledge; secondly, to enable us to deliver and make out that knowledge to others."
>
> LOCKE.

No. 78.] SATURDAY, MARCH 18, 1826. [Price 3*d*.

MR. HUBBARD'S FOLDING CHAIR.

Fig 1

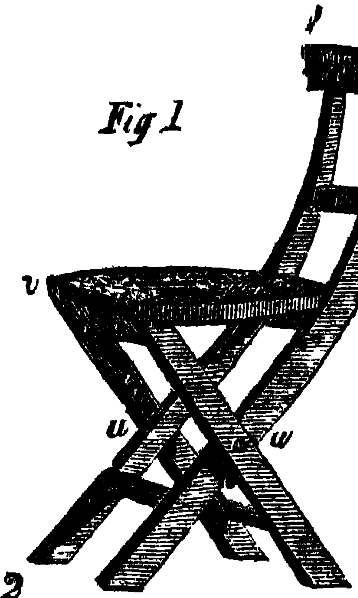


Fig 2

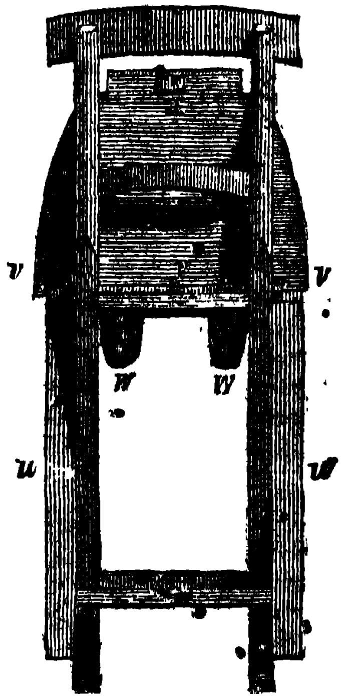
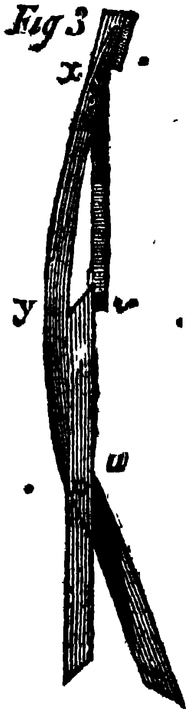


Fig 3



MR. HUBBARD'S FOLDING CHAIR.

In camp, on board ship, and in other situations in which stowage-room is very limited, demands are continually making on the ingenuity of the cabinet-maker to compress into as small a space as possible all articles of domestic furniture when not actually in use. The common camp-stool, either with or without a back, thus forms a substitute for a chair; but the webbing does not make a very firm or convenient seat, and this circumstance induced Mr. Hubbard, of Leadenhall Street, (who is not a cabinet-maker,) to add to it a folding wooden seat, with a spring catch. The result is, a light chair of a very firm and simple construction, which may be afforded at a small cost, and when not in use, may be hung upon a peg, or may be stowed away in any other manner, occupying not more than one-third of the space required for a chair of common construction.

Fig. 1. (Vide Frontispiece.) shews the chair when open or ready for use. It consists, like the camp-stool with a back, of two frames crossing each other, and united by the screw-pins *u u*; *v* is the wooden seat, having two hinges *v v* in front, and a hole, *x*, at the back, to receive the spring-catch, *y*, in the back rail, as shewn fig. 2.; beneath the seat are two pieces of webbing, *w w*, to limit the expansion of the two frames, and thereby cause the spring-catch to fall into its hole without any trouble. Fig. 3. is a side-view of the chair when folded. (*Trans. Soc. Arts, Vol.* 43.)

LONDON MECHANICS' INSTITUTION.

MR. FREND'S

FOURTH LECTURE ON GEOGRAPHY.

HISTORY — CHRONOLOGY — GEOGRAPHY —ANCIENT STATE OF GREAT BRITAIN; IMPORTANCE OF ITS COAL MINES, &c. —ASIA; ITS BOUNDARIES AND INHABITANTS—CHINESE, HINDOOS, ARABIANS, AND JEWS—CHINA; ITS ANTIQUITY — CHINESE LANGUAGE AND BOOKS—PRINTING—DECIMAL ARITHMETIC—RIVERS AND CANALS OF CHINA —CHINESE AGRICULTURAL FESTIVAL, &c.

WEDNESDAY, MARCH 8TH.

In continuation of his judicious remarks on the various countries which form the surface of the earth, Mr. Frend commenced the present lecture by adverting to the observation of an Eastern writer, that "the heavens were for the Supreme, and the earth was given as an heritage for the sons of men." Whoever takes the pains to examine the earth which we inhabit, must be convinced that this heritage is a goodly one, and it is an important object that all mankind should be acquainted with the nature of their inheritance; for the earth was given to the *sons of men*—not to one man only, but to men in general.

Now the object of History is to give an account of the persons who have inhabited the earth, from the earliest records to the present time, and a sad and doleful account does the page of history exhibit to our view; for if, continued the Lecturer, I were to mark with red, on the globe before us, every spot which has been stained with the blood of our fellow creatures, the globe would present an appearance truly lamentable. Let us hope, however, that mankind will at last see their real interest, and instead of cutting each others throats, endeavour to make the best use of their own inheritance.

It is the part of Chronology to give an account of all the principal events that have happened in the times that are past; but the records of our nation are limited to a period of about 2000 years, while other countries are able to trace their origin to a much more remote date. The province of Geography is to point out the situations of the various places on the earth's surface, and it is our business to make ourselves acquainted with the characters and peculiarities of the different inhabitants of these places; and in this research, we shall find that some of them possess advantages of one kind, and some of another; but if the whole were to unite their various advantages, for the mutual benefit of mankind in general, the earth might, to use a common expression, be converted into a paradise.

The Lecturer then pointed out on the globe the small spot which this island occupies on its surface, and asked what was its state 2000 years ago? The country was then the same as it is now; its hills, its rivers, and its plains occupied the same situations as they do at the present day, but is there not a striking difference between the state of the country at that period, and the state in which we see it now? At that time it was inhabited by a people who were totally unacquainted with the treasures it contained; generation succeeded generation, all equally ignorant of the riches within their grasp, though the possession of this wealth is now so familiar to us, that we think but little of it. Here, continued Mr. Frend, pointing to Northumberland, is a mine of wealth, more valuable to this country than the mines of Potosi or Peru; for the discovery of our coal-mines, about 300 years ago, has contributed more to the improvement and embellishment of this kingdom, than all the labours of the 2000 preceding years could effect without this assistance.

We often hear of the wisdom of our ancestors, but in what did their wisdom consist? It taught them, its seems, to live in a barbarous manner, but it did not enable them to discover the value of the country they inhabited. In fact, this hacknied reference to the wisdom of our ancestors is entirely a mistake. The period to which we allude was the youth of the world; and mankind, even at the present time, are so far from having arrived at old age, that they can hardly be considered out of their leading-strings. Men have arisen who have opened new fields of treasure to the world, and then tyrants have arisen, whose career of iniquity has rendered these treasures nugatory, and who have left mankind in the same state of ignorance as before. For my part, continued Mr. Frend, I scarcely ever knew an instance of an appeal to the wisdom of our ancestors, except from a want of argument, or for the purpose of supporting some falsehood or trickery. I feel a great respect for our ancestors, and owe them a tribute of gratitude for whatever truths they have discovered and illustrated; but I like to form my judgment according to the dictates of common sense, and not to take a thing for granted, merely because my great-grandmother told it to my grandmother, my grandmother to my mother, my mother to my nurse, and my nurse to me *(Laughter)*.

Mr. Frend having, in his previous lecture, explained the most important particulars relating to Africa, proceeded to direct the attention of his hearers to Asia, which constitutes the second and principal part of the greater of the two immense Islands to which he had already adverted. Asia is bounded on the North by the Northern Ocean; on the South, by the Southern and Indian Oceans; on the East by the great Pacific Ocean; and on the West, partly by the Red Sea, the Isthmus of Suez and the Mediterranean, and partly by Europe; but the Eastern boundary over land which passes through the Russian Empire, is not very clearly defined. In our description of Africa it was mentioned, that it is situated in the torrid and the two temperate zones, and it will be seen by a reference to the globe, that Asia also extends to three zones, viz., the *torrid*, and the northern *temperate* and *frigid* zones. Now, it will naturally be supposed that, in so vast a tract of land as Asia, which is exposed to every variety of climate, a corresponding difference will be found in the manners and customs of its inhabitants, some of whom reside amidst the eternal snows of Siberia, while others are exposed to the opposite extreme of temperature in the torrid regions bordering on the Equator. The contrast between the inhabitants of Siberia at the Northern extremity of Asia, and those of Hindostan, in the Southern parts, is therefore very striking; and there is also a great difference between the people of China, on the East, and those of Arabia, on the West; the former country being abundantly supplied with water from numerous rivers and canals, while the latter contains vast deserts, over which traffic can only be carried on by means of camels.

Asia may be separated into five principal divisions, comprehending the Northern, Southern, Eastern, Western, and Central parts; and, in considering the characteristics of the inhabitants, there will be occasion to speak of four distinct races of men, viz., the *Chinese*, the *Hindoos*, the *Arabians*, and the *Jews*, each of which is distinguished from the rest by many striking peculiarities.

China is a very extensive empire, comprehending a territory nearly equal in size to two-thirds of Europe, and if we include Chinese Tartary, this country may be considered almost as large as the whole of Europe. The population of China is exceedingly numerous, and the language, manners and customs of the Chinese are so totally different from those of the rest of the world, that some confirmation is given to an ancient tradition, which records, that when Noah descended from the Ark, he travelled Eastward, and founded the empire of China, while his sons, journeying Southward, peopled the other parts of the earth. Certain it is, that the Chinese are a very ancient people, and that while the inhabitants of England, from the lowest ranks of society to the king upon his throne, are unable to trace their origin for more than 2000 years back, the records of China embrace a period of far more remote antiquity.

It has been stated, that the language

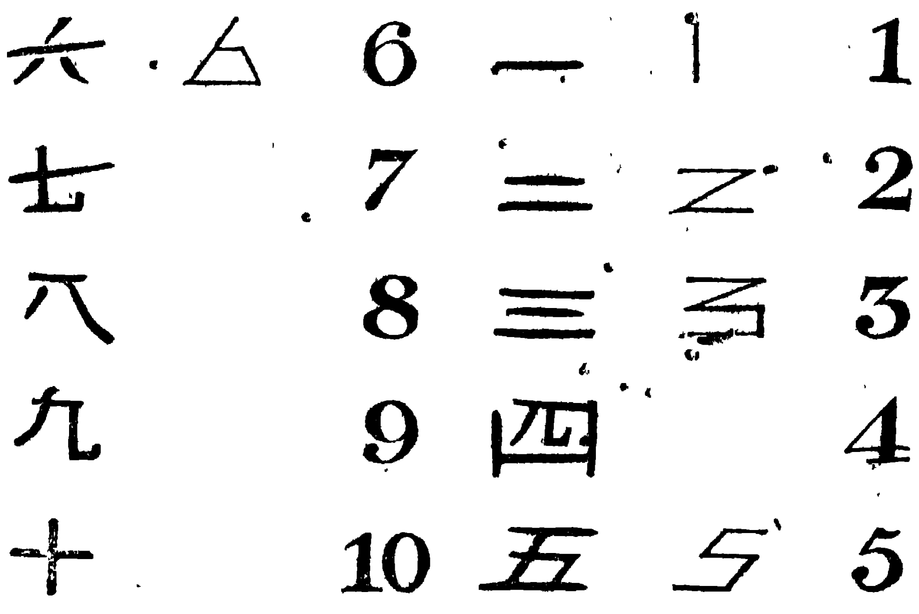
of the Chinese is totally different from that of any other nation, and it should be observed, that it consists entirely of words, or arbitrary characters, which are not divided into letters, like the words composing the European languages. Mr. **Frend** here produced a Chinese book, printed on the fine thin paper manufactured in China, and comprising several hundred pages. All the leaves were *double*, to prevent the impression of the characters from being visible on the opposite sides of the pages; and the front edges of the leaves, though they were all doubled inwards, were arranged with as much neatness and precision as if they had been cut in the same manner as English books.

The art of printing was known in China long before it was introduced into any of the European nations, but the Chinese do not use *moveable types*, as we do; for their mode of printing has always been from *blocks*, on which whole pages of letters are cut. Their method, therefore, resembles our mode of printing from wooden blocks, and as their blocks form complete pages, it is somewhat analogous to *stereotype printing*.

There are some peculiarities attached to the Chinese method of reading, which appear rather singular to an English eye. In the first place, the *beginning* of their books is at what we should consider the *end*, and consequently they would appear to us to read *backwards*. In the next place, instead of reading as we do, from the *left* of the page to the *right*, the Chinese read from the *top* of the page to the *bottom*. There are, indeed, four different ways of reading adopted in different languages, viz., from left to right—from right to left—from top to bottom—and finally, a method which has been denominated *boustrophedon* (bull-turning), because the reading is backwards and forwards alternately, like the motion of an ox in ploughing a field.

Mr. Frend next adverted to the proficiency of the Chinese in arithmetic, and explained their mode of teaching it, by exhibiting an instrument bearing some resemblance to the Roman *Abacus*. This instrument was in the form of a parallelogram, and was divided from top to bottom by a series of thin parallel rods, about half an inch apart, on which a number of small wooden balls were made to slide backwards and forwards freely; and any number, from unity up to trillions, might be expressed by the situations of these balls upon the rods which passed through their centres. The parallelogram was divided from right to left into two unequal parts, and on each of the rods were seven balls; two of them in the upper or smaller, and five in the lower or larger division. A single ball on the *lower* division of the first rod signified 1, on the second rod 10, on the third 100, on the fourth 1000, &c., and a single ball on the *upper* divisions of the same rods signified 5, 50, 500, 5000, &c. Thus it was easy to express any number by varying the situation and number of balls on the rods, and the Lecturer observed, that the Chinese, in making calculations by means of this apparatus, run their fingers over it as rapidly as a performer moves the keys of a piano-forte.

A large diagram of the Chinese numerals, from 1 to 10, was then exhibited, which is correctly represented in the following engraving:—



Mr. Frend, in explaining this diagram, expressed his opinion, that our numerals, the invention of which is generally attributed to the Arabs, were, in reality, derived from the Chinese, and this idea he founded upon the resemblance which may be traced between several of our figures, and the corresponding numerals in the diagram. The 1, for instance, is expressed in both cases by a single straight mark, the only difference being, that the Chinese mark is horizontal, and ours perpendicular. An endeavour to join the Chinese strokes of the 2 and 3, so as to form the figures with more facility, would produce an approximation towards their present form in this country. The same remark may be applied to the 6, and the resemblance of the two fives to each other is very obvious. The analogy between the other figures is not so clear, but as we find a resemblance between so many of them, it is fair to presume, that the rest have the same origin, and have assumed their present form by transitions which cannot be so distinctly traced. [We have endeavoured, in our engraving, to elucidate Mr. Frend's remarks, by introducing the intermediate characters, which will convey an idea of the gradual change of form which he supposes the Chinese numerals to have assumed.]

The Lecturer here eulogised the *Decimal* system of Arithmetic adopted in China, and expressed his regret that a similar method was not introduced into this country. He was sorry that, upon the recent occasion of equalizing the weights and measures, the same opportunity was not embraced for establishing a *decimal division* of the currency, and also for dividing the weights and measures upon a similar principle. The sovereign at present in circulation might have been divided into 10 shillings, the shilling into 10 pence, and the penny into 10 farthings. An attempt was made some years since, by an intelligent Member of Parliament, to call the attention of the House of Commons to an improvement of this kind, but it did not succeed, probably because it was so simple, so advantageous, and so unexceptionable.

The general state of the vast empire of China affords striking indications of the indefatigable industry of its inhabitants, and among its natural advantages may be mentioned an abundant supply of water, principally from two great rivers proceeding from the Himelayan mountains. To these and other rivers the Chinese, by great perseverance, have added an astonishing number of canals, many of them of immense length. In England, the completion of a canal of 100 miles is considered an extraordinary circumstance, but some of the Chinese canals are upwards of 1000 miles in length; and such is the anxiety of the inhabitants to improve their inland navigation, that, wherever there is a river affording a sufficient quantity of water for the purpose, canals are cut to every town or village which it is capable of supplying. The Lecturer then described the method of constructing canals in China, and observed that the dams in our river Ouse afford an apposite illustration of this subject.

Mr. Frend then proceeded to speak of the commerce of China, the proficiency of the Chinese in the mechanical arts, their improvements in gardening, and the veneration in which they hold agriculture. This is particularly evinced by an extraordinary annual ceremony, which may be termed the Agricultural Festival, and which is celebrated by a vast assembly of all ranks of society. At this festival, the Emperor himself, who is called by his subjects the Son of Heaven, puts his hand to the plough, and turns the first furrow. He is followed by the nobility; and the farmers, with their assistants, finish the work.

Mr. Frend observed that he must defer, till his next lecture, some other remarks relative to China, and he concluded by alluding to the various *interests* into which men are divided in this country, such as the agricultural interest, the landed interest, the mercantile interest, and the monied interest, all of which he considered to be mutually dependent upon each other. The landholder, for instance, bears the same relation to the farmer that the money-holder bears to the merchant; for the farmer pays the landholder for the use of his land, as the mercantile man pays the money-holder for the use of his money. All of them should, therefore, consider themselves as possessing but one common interest, and should unite their exertions for the benefit of mankind in general.

MR. TATUM'S
THIRD LECTURE ON ELECTRICITY.

REMARKS ON THE CONSTRUCTION OF VARIOUS ELECTROMETERS — THEIR USE AS MEASURES OF INTENSITY, BUT NOT OF QUANTITY — ELECTROPHORUS —

ITS AGENCY IN PRODUCING INSTANTANEOUS LIGHT BY THE IGNITION OF HYDROGEN — CONVEYANCE OF THE ELECTRIC FLUID FROM THE POSITIVE TO THE NEGATIVE CONDUCTOR — PASSAGE OF THE FLUID THROUGH THE HUMAN BODY, &c.

FRIDAY, MARCH 10TH.

After briefly recalling to the recollection of the members the subjects discussed in his preceding lecture, Mr. Tatum proceeded to exhibit and describe the operation of the various *electrometers* which are used for the purpose of indicating the presence of electricity in the substances presented to them. The most delicate and susceptible of these is the *gold-leaf electrometer*, which is affected by the lowest degrees of intensity, and the next in order is the *pith-ball electrometer*, which is also very susceptible, and is acted upon by very low degrees of intensity. There are also the *striking electrometer*, which may be attached to the conductor of the machine, to measure the intensity of the charge communicated to a jar — the *quadrant electrometer*, in which the degree of intensity is pointed out by an index, moving along a graduated scale — and the *steel-yard electrometer*, the operation of which depends on the principle of the lever.

Having described all these instruments, Mr. Tatum proceeded to express his opinion, that they were all *measures of the intensity of electricity*. If one body be presented to the cap of the gold leaf electrometer, the leaves will perhaps diverge one-eighth of an inch; another substance will cause them to diverge a quarter of an inch; a third substance an inch, &c. Therefore this instrument is as complete a measurer of intensity as any of the others. If any person could devise a method of measuring the *quantity*, as well as the intensity, of the electric fluid, a very desirable object would be obtained; but the instruments under consideration only point out the degrees of intensity, and they are all properly denominated *electrometers*, or measurers of electricity, so far as its intensity is concerned.

To shew that the electrometer does not indicate *quantity*, Mr. Tatum made use of the striking electrometer while he charged a jar of the usual size, which required 11 turns of the machine to charge it. One of the large battery jars was then charged in the same manner, but this was not effected till the cylinder had been turned about 33 times. Now, it is evident, that in the latter case, a much greater *quantity* of electricity is elicited than in the former, but as the surface of the jar is so much larger, this additional quantity is necessary, in order to distribute over it a degree of intensity equal to that of the smaller jar.

Mr. Tatum then adverted to the observation he had made in his first lecture, that all the phenomena of electricity may be explained by electrical *attraction*, without the aid of a principle of *repulsion*; and applying this remark to the pith-ball and gold-leaf electrometers, he stated, that the divergence of the balls or leaves was not caused by their repelling each other, but was owing to their being attracted by the sides of the glass, to which slips of tinfoil are sometimes attached, and which are in a dissimilar state of electricity. The Lecturer here referred to a diagram, to shew that each of the balls is surrounded by an atmosphere of electricity; and the electricity of these atmospheres being of the same kind, they have no attraction for each other, but are attracted by the glass, which is in the opposite state of electricity. Another cause of the divergence of the leaves or balls is the attraction of the air contained in the vessel; for if the electrometer be exhausted, they will not diverge when an excited substance is presented to the cap of the instrument.

Mr. Tatum next explained the construction of the *electrophorus*, an instrument consisting of a plate covered with a resinous substance, with which the surface of an insulated metallic plate was brought into contact; and the metallic plate being in a *positive*, while the resinous cake was in a *negative* state of electricity, an electric spark was distinctly seen passing to the Lecturer's hand, every time the former was lifted from the latter. Upon this principle an apparatus has been constructed for the production of instantaneous light, by causing the sparks produced by the electrophorus to ignite a minute jet of *hydrogen gas*. Mr. Tatum described the construction of this instrument, and would have exhibited its operation, but the apparatus not being in perfect order, he was apprehensive of the possibility of an explosion, and therefore postponed the experiment. He had kept an instrument of this kind in action for nearly three months together, under favourable circumstances, and during a period of fine summer weather; for as only a very small portion of hydrogen need be expended to obtain a light when it is required, a considerable time may elapse before a fresh supply is necessary. The apparatus must, however, be kept in a perfectly dry place, and it certainly affords a much more elegant and philosophical mode of producing light, than the ordinary process adopted with the flint and steel.

Additional branches were then attached to the *positive* and *negative* conductors of the electrical machine, and the balls being placed opposite to each other, the chain which connected the machine with the earth was removed, and a light substance being suspended between the two conductors, it was seen rapidly travelling backwards and forwards, when the cylinder was turned, to convey the electric fluid from the *positive* to the *negative* conductor. The two conductors were then brought nearer to each other, and the machine being again put in revolution, a powerful spark was seen passing from the positive to the negative conductor, and the stream of electricity assumed the *zig-zag* or *tortuous* course which is always observed, under similar circumstances, in its passage through the atmosphere. The object of these experiments was to prove, that when the supply of electricity from the earth is cut off by removing the chain, the *redundant* portion of the electric fluid passes from the *positive*, to supply the *deficiency* of the *negative* conductor. This was rendered more evident by repeating the last experiment when the chain was attached to the machine; for in this case, instead of a continued stream of electricity, only a slight spark passed at intervals between the conductors; and the Lecturer remarked, that if the atmosphere were perfectly free from humidity, no spark would be seen at all.

Some unobserved derangement of the machine, which was soon remedied, occasioned a little delay in the performance of these experiments; and the Lecturer, after exhibiting some others, which we have before had occasion to describe, concluded by demonstrating, in his own person, the passage of the electric fluid through the human body. Having insulated himself, by standing on a stool with glass legs, he placed his left hand on the positive conductor of the machine, and holding a conductor in his right, he presented it towards his assistant's head and hand, while the cylinder was turned, and the sparks were instantly seen passing in rapid succession from the extremity of the conductor which he held. Mr. TATUM observed, that the convulsive motion produced by this operation rendered it impossible for him to hold his arm steady while the fluid was passing through it; and he added, that in his next Lecture he would afford the Members an opportunity of appreciating this convulsive motion, by shewing that a great number of them might experience it at the same moment.

Mr. M'WILLIAM then gave notice that the Writing Class alluded to in the Quarterly Report, would be opened on the following Evening, (Saturday, March 10,) under the superintendance of Mr. Collins, jun.—As there were a few vacancies in this class, he requested those Members who were desirous of joining it, to make immediate application to the Secretary.

LECTURES FOR NEXT WEEK.

Monday, March 20, and Thursday, March 23, MR. TATUM's Fifth and Sixth Lectures on Electricity.

NOTICE RESPECTING MR. WALLIS'S LECTURES ON ASTRONOMY.

At the close of Mr. FREND's Lecture on Wednesday evening last, Mr. M'WILLIAM announced to the Members that Mr. WALLIS would commence his Course of Lectures on Astronomy, on Wednesday, the 5th day of April next, and that, as Mr. WALLIS's extensive machinery and transparencies would occupy a considerable portion of the Theatre, it had been arranged by the Committee, that the Course should be delivered twice; the Lecture of each Wednesday being repeated on the succeeding Friday. By this means, the necessity of removing the machinery would be obviated, and an opportunity would be afforded for every Member to obtain an advantageous view of the splendid transparencies, without the Theatre being inconveniently crowded.

Mr. M'William added, that Mr. Tatum, in order to complete his Course previous to the commencement of Mr. Wallis's, would deliver the remaining five Lectures, on the following evenings:

Friday, March 17th.
Monday, March 20th.
Thursday, March 23d.
Wednesday, March 29th., and
Friday, March 31st.

To prevent disappointment, it is important that the Members should notice the substitution of Monday and Thursday for Wednesday and Friday (Good Friday) in next Week.

ROTHERHITHE AND BERMONDSEY MECHANICS' INSTITUTION.

The First Quarterly General Meeting of the Members of this Institution was held on the 9th inst. in a neat and commodious Baptist Chapel, Jamaica-row, Bermondsey, which place the Committee have engaged for the delivery of lectures in, and for other purposes of the Institution.

The Report of the Committee for the past Quarter was read by Mr. Pelham, and received with every possible mark of satisfaction.

It stated the amount of money received, and expended, and the balance in hand:

The list of donations, with the donors' names, which were numerous:

The number of volumes forming the library, nearly 300:

The number of members who had joined the Institution since the 12th of December 1825, viz. 150; and the total number constituting the Institution, viz. 302.

It further stated, that the Committee had engaged Reading Rooms, situate in the most central parts of Rotherhithe and Bermondsey; and the pleasure the Committee had in witnessing the attendance of the members thereat:

That they continued to receive the most flattering promises from eminent and scientific gentlemen, to deliver gratuitous courses of lectures, and, finally, recommended the following alterations in the laws:—

"That persons of the age of twelve years may be admitted members of this Institution; but that no member shall be allowed to vote or ballot at any of the meetings, nor fill any office therein under the age of 21 years."

Upon this Resolution being moved and seconded, and reasons being urged for its adoption, the junior members of the Institution violently opposed it, which led, we are sorry to say, to much unnecessary discussion; and we regretted witnessing considerable excitement, occasioned by the injudicious remarks and the more injudicious opposition to the views of the Committee, and the senior members of the Institution.

The law which the resolution is intended to alter, stands:—"That all persons, on becoming members, shall have the power to vote, ballot, &c.; but no one under the age of 21 years shall fill any office, &c."

This, the Committee thought, gave too much power to the junior members, while the juniors contended, they had a right to legislate, and were as fully capable of using that power as their seniors.

The resolution for altering the laws was, however, carried by a very great majority.

INTRODUCTION TO THE STUDY OF BOTANY.

(Continued from page 329.)

CLASS 2. DIANDRIA.

16. The second botanical class, DIANDRIA, is distinguished by its two stamens. Its *orders* are three.

17.—1. *Monogynia,* one pistil; among the native plants of this order, we find the *privet* growing in hedges and chalky soils; its botanical name is *Ligustrum.* It is my intention to select a plant in each class to describe, so as in some degree to initiate the student into the technicalities of Botany. I, therefore, select the *Ligustrum vulgare,* common privet, as an example of this class. It is a shrub about six or eight feet high, with straight branches placed opposite to each other, filled with pith. The leaves grow on short stalks, lanceolate or oblong, and tapering to each extremity. It flowers in May and June. The *calyx* is tubular, with four upright teeth. The *corolla* white, of one petal, funnel-shaped, and divided into four deep, egg-shaped, spreading segments. The *stamens* are opposite to each other. The *germen* oval, the *style* short with a thick and cloven *stigma.* The *berry* has two cells, each cell containing two seeds.

18. The genus *Circæa, enchanter's nightshade* has two species. It is known by the two petalled corolla, the calyx being of two segments, and the capsule of two cells.

19. The *veronica, speedwell,* of eighteen species, with some of which every one is familiar. The corolla consists of one petal, wheel-shaped; the capsule of two cells.

20.—2. *Digynia,* two pistils, has only the genus *Anthoxanthum, sweet scented vernal grass,* which is said to be the cause of the delighful smell of new hay.

21.—3. *Trigynia,* three pistils, has no native plants, but contains the valuable foreign genus of *Piper,* which has no corolla, nor calyx.

22. Among the exotics of this class are the *sorrowful-tree* (*Nyctanthes Arbor-tristis*) of the East Indies; the *olive* (*olea*); the *Jessamine* (*Jasminum,*) and the *vervain (verbena).*

CLASS 3. TRIANDRIA.

This class is as usual distinguished by the number of stamens, which is four. Its *orders* are three.

1. *Monogynia.* This order contains the "*golden crocus,*" which I select as an example of this class. On examining, we find the stamens are three and the pistil one, which determines it to be the class Triandria, order Monogynia. The *calyx* is radical, that is, springs from the root, consisting of two unequal membranous, tubular sheaths. The *corolla* is of one petal, divided into six equal segments; the *tube* three or four times the length of the *limb.* The *filaments* are white, and shorter than the limb of the corolla; the *anthers* arrow-shaped. The *style* is thread-shaped, rising as high as the stamens; the *stigma* three, variously folded and jagged. The *germen,* afterwards becoming the capsule, is at the root, of a roundish form. The *capsule* has three cells and three valves. There is no stalk or stem, and the leaf is *linear;* that is, all of the same breadth, except it be at the base and point.

25. The genus *Valeriana,* valerian, has the corolla of one petal divided into five segments, with a protuberance, spur, or nectary on one side at the base, containing honey; and but one seed crowned with many feathery rays. There is a peculiarity, which fortunately is not frequently met with, and as it occurs here, we will notice. The greater number of the species of Valeriana have three stamens, but the *Valeriana rubra,* red valerian, has only one; now, this latter is placed with the rest of the family in this class, since by far the greater number have three stamens.

26. The *Iris,* with which most people are acquainted, belongs to this order. The yellow species (*Iris pseudo-acorus*) with large, handsome, yellow flowers, is met with in ditches and pools. The corolla has six deep unequal segments, the inner being smallest; the stigma is like a petal, and larger than the inner segments.

2. *Digynia,* consists almost entirely of grasses, which are too minute and difficult for the student at present. It is worthy of remark, that although there are upwards of 300 species, only one is poisonous.

3. *Trigynia,* contains no English plants.

CLASS 4. TETRANDRIA.

This class is known by the stamens being four, and all of the same length, which distinguishes it from the class Didynamia. Its orders are three.

30.—1. *Monogynia,* one pistil. In this order is the genus *Dipsacus,* teasel, whose flowers have a calyx of many leaves, surrounding a group of florets, called the *common calyx,* and each of these small flowers has a calyx of its own, termed the *proper calyx.*

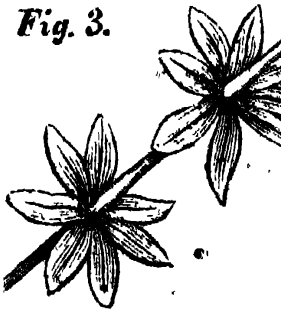
31. The *Scabiosa,* scabious, grows in corn-fields and pastures, very much resembling the Dipsacus.

32. *Sherardia,* field-madder, is a small plant, generally about four or five inches high, with pale blue monopetalous flowers.

33. *Galium,* bed-straw, a more extensive genus than the last, being of seventeen species. The flowers are small; the leaves surround the stem, standing out like the spokes of a wheel from the nave. This ring is called a whorl, or the leaves are said to be *verticillate* (as fig. 3.), and are armed

with minute bristles, so as to stick to the hand and clothes when touched.

Fig. 3.



34. Suppose we have found in the month of May a small and delicate plant, with pure white flowers. We find the stamens are four, and pistil one; the class to be Tetrandria, order Monogynia. On examining more minutely, we find the corolla monopetalous and tubular; and the seeds naked, globular, and not crowned by the calyx. This agrees with the generic description of the *Asperula*, woodruff. The stem is about a span high; and the leaves form a *whorl*, about eight in each whorl, of a bright green colour. The flowers are *panicled*, that is, a number of small flower stalks arise from a common peduncle; the *calyx* is cut into four small teeth; the *corolla* is funnel-shaped; the *tube* nearly cylindrical and the *limb* divided into four deep, oblong, spreading segments; its colour is white, and contains four stamens, whose filaments are short, situated in the mouth of the tube, supporting *anthers* composed of two round lobes; the *germen* consists of two roundish lobes, supporting a thread-shaped *style*, with a small *stigma*. The *seeds* are two, naked, rough, and globular. All these particulars determine our plant to be the *asperula odorata*, sweet woodruff.

35. We have here also the *Plantago*, plantain; *Exacum*, gentianella; *Centunculus*, chaff-weed; *Sanguisorba*, burnet, &c.

36.—2. *Digynia* has only one British genus, *Briffonia*.

37.—3. *Tetragynia*, four pistils, here is the *Ilex* or Holly, too well known to require a description; likewise *Potamogeton*, pond-weed; *Ruppia*, ruppia; *Mænæchia*, mænchia, &c.

Class 5. Pentandria.

This is an immense class of seven orders.

38.—1. *Monogynia*. The plant I select as a specimen of this class and order, is the *Hyosciamus niger*, common henbane. The generic characters, the characters which shew what genus a flower belongs, are the corolla being monopetalous and funnel-shaped; the stamina being inclined; and the capsule two-celled, covered with a lid. Its species is known by the leaves embracing the stem, and having deep-rounded indentations, called botanically *sinuated* leaves; and by the flowers being sessile, that is, joined immediately to the stem without a peduncle.

39. This annual plant grows in waste ground, banks, and commons, especially in dry chalky soil.

40. It flowers in June and July.

41. The root is spindle-shaped, that is, thick above, and smaller as it descends. The stem is bushy, and about two feet in height. The leaves are sessile, joined to the stem without a petiole; large, downy, sinuated, alternate, and of a sea-green colour. The flowers arise from the bosoms of the crowded upper leaves; the corolla consists of a short cylindrical *tube* with a spreading *limb*, which is divided half-way into five obtuse rounded segments, of an elegant straw-colour, pencilled with dark purple veins; the calyx is tubular, and consists of one leaf, divided into five acute segments; the filaments are awl-shaped and downy at the base, supporting purple heart-shaped anthers, and are inserted into some part of the *tube* of the corolla; the style is longer than the corolla, and ends in a blunt stigma; the capsule is egg-shaped, invested with the body of the calyx, and contains numerous seeds.

42. The whole plant exhales a powerful and oppressive odour, which immediataly leads us to suspect its [illegible]

43. This order contains the *Primula*, primrose, a general favourite, needing no description. The cowslip and oxlip are species of *primula*.

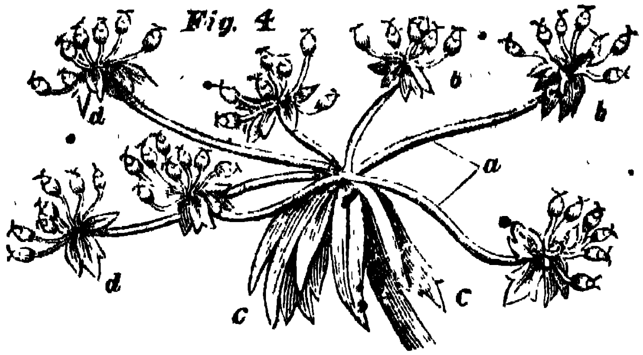
44. The *Viola*, violet, which comprises "the *pansy* freaked with jet."

There are about eight species of *viola*.

45. *Ribes*, currants and gooseberries growing wild in the north of England.

46. And many other far too many even to name.

Fig. 4



47.—2. *Digynia*.—This order contains the numerous tribe of umbelliferous plants, from the study of which the botanist generally shrinks. These plants have a number of flower-stalks growing from one point, each bearing a flower, thus forming what is called the *universal* umbel, (*a*. Fig. 4.) and each of these peduncles or flower-stalks divide into a number of smaller peduncles, thus forming the *partial* umbel. (*b*.) But if these spokes or peduncles, which start from the universal umbel, instead of springing from a point, are scattered irregularly, and the flowers form a flat surface on the top, as in the common elder, then it is called a *cyme*.

48. In the third paragraph, I mentioned the *involucrum* as a species of calyx, it is not, however, a legitimate one, although considered as such. It is those leaves (*c, c*,) at the base of the universal umbel, therefore called the *universal involucrum*; but at the base of the partial umbel there are several leaflets which are termed the *partial involucrum*.

49. In this order stands the *Daucus*, carrot, *Pastinaca*, parsnip; *Carum*, carraway; *Apium*, celery: "the seeds and whole plant in its native ditches are acrid and dangerous, with a peculiar strong smell and taste; yet, by culture, it becomes the mild and grateful celery;" the *Eryngium*, eringo, whose roots are sold candied, being reckoned stimulating and restorative; *Orithmum* samphire, much used formerly as a pickle, &c.

3. *Trigynia* contains five British genera, among which is the *Sambucus*, elder, whose black berries are often used to make wine.

4. *Tetragynia* contains only the genus *Parnassia*, grass of parnassus.

5. *Pentagynia* has three genera.

6. *Hexagynia*, only one, the *Drosera*, sundew.

7. *Polygynia*, pistils numerous, but one genera.

Rye. TYRO.

The Reader is requested to make the following corrections in the first paper. Par. 1. for aculens read aculeus. Par. 9. for nutary, read nectary.

OBSERVATIONS ON MR. PERKINS'S EXPERIMENTS RELATIVE TO THE COMPRESSIBILITY OF WATER.

HAVING filled a cylinder, 3 feet long, and 4 inches in diameter, with water, into which a rod or piston was passed through a stuffing box, and having a sliding ring upon the rod, the whole was lowered 500 fathoms into the sea, when it appeared by the situation of the sliding ring, that the column of water which pressed upon the piston had sunk it so as to have compressed the water a one-hundredth part of its bulk. The same apparatus was placed in a cannon filled with water, and secured air-tight, when a pressure equal to 500 fathoms, was forced in by means of the hydraulic press; and the same results as in the experiment in the ocean took place.

Allowing the full force to both these experiments, the first of which was, we understand, performed in a voyage from Philadelphia to England, we cannot by any means think that they are conclusive of the compressibility of water. In the experiments we are not informed at what temperature was the ocean or the air, nor of what temperature was the water used in the cylinder, nor what kind of water; and till these things are accurately determined, no results of this kind can be conclusive. We may observe, *en passant*, that, very probably, *temperature* may be the cause of those extraordinary occurrences so often mentioned to have taken place in bottles with only *air* in them, when lowered to considerable depths in the sea; viz. that the cork was pressed into the bottle, and the bottle brought up full of water. Now, nothing is more likely than that a diminution of the volume of air by decreased temperature takes place in such experiments, and a vacuum in such case being formed within the bottle, the external pressure of course pushes in the cork.

London Road. T. TAYLOR.

AIR FEEDER FOR FIRE PLACES.

To the Editor of the Mechanics' Register.

SIR,—In warming apartments by fires in the ordinary way, a considerable quantity of air is consumed; to replace which, an equal quantity must by some means gain admission to the apartment, causing unpleasant drafts, and if the room contains no crevices at the doors or windows, a portion of air will force its way down the chimney, bringing with it the smoke; this is the cause of many smoky chimneys—very few chimneys smoke when a door or window is left open. I know a chimney which has given its proprietor a world of trouble; the chimney-pot has been raised, and the mantle-piece lowered, but without any good effects. Now the windows of the room are almost air-tight, and the door is bordered with leather *to prevent drafts*, and the natural consequence is what I have just stated, the chimney will smoke in spite of every body. Now if a small opening were made at the back of the under part of the grate, having a communication, by means of tubes, with the external air, which should strike against a sloping sheet of iron, to conduct it straight up to the fire, I think there would be an end to smoky chimneys, unpleasant drafts, &c. The fire would burn better, and give out more heat, for instead of a current of cold air being drawn from all parts of the room towards the fire-place, the air would pass from the feeder into the fire, and being heated would expand, and part entering the room would communicate to it an agreeable warmth; of course the plate of iron must be placed sufficiently backward to avoid catching the dust, ashes, &c.—Leaving this suggestion to the consideration of your scientific readers.

Yours respectfully, W. B. jun.

10, *George Yard, Lombard-st.*

March 14th, 1826.

OBSERVATIONS ON THE MANUFACTURE OF WRITING INK.—By Dr. Ure.

Common ink for writing is made by adding an infusion or decoction of the nut-gall to sulphate of iron, dissolved in water. A very fine black precipitate is thrown down, the speedy subsidence of which is prevented by the addition of a proper quantity of gum-arabic. This is usually accounted for by the superior affinity of the gallic acid, which, combining with the iron, takes it from the sulphuric, and falls down. But it appears as if this were not the simple state of the facts; for the sulphuric acid in ink is not so far disengaged as to act speedily upon fresh iron, or give other manifestations of its presence in an uncombined state. According to Deyeux, the iron in ink is partly in the state of a gallate.

M. Ribaucourt paid particular attention to the process for making black ink, and from his experiments he draws the following inferences:—That logwood is a useful ingredient in ink, because its colouring matter is disposed to unite with the oxide of iron, and renders it not only of a very dark colour, but less capable of change from the action of acids, or of the air. Sulphate of copper, in a certain proportion, gives depth and firmness to the colour of the ink. Gum-arabic or any other pure gum, is of service, by retarding the precipitation of the feculæ; by preventing the ink from spreading or sinking into the paper; and by affording it a kind of compact varnish or defence from the air when dry. Sugar appears to have some bad qualities, but is of use in giving a degree of fluidity to the ink, which permits the dose of gum to be enlarged beyond what the ink would bear without it. Water is the best solvent.

Lewis had supposed that the defects of ink arise chiefly from a want of colouring matter. But the theory grounded on the fact discovered by M. Ribaucourt requires, that none of the principles should be in excess.

It is doubtful whether the principles of the galls be well extracted by maceration; and it is certain, that inks made in this way flow pale from the pen, and are not of so deep a black as those wherein strong boiling is recurred to.

From all the foregoing considerations M. R. gives these directions for the composition of good ink:—

Take eight ounces of Aleppo galls (in coarse powder); four ounces of logwood (in thin chips); four ounces of sulphate of iron; three ounces of gum-arabic (in powder); one ounce of sulphate of copper; and one ounce of sugar-candy. Boil the galls and logwood together in twelve pounds of water for one hour, or till half the liquor has evaporated. Strain the decoction through a hair sieve or linen cloth, and then add the other ingredients. Stir the mixture till the whole is dissolved, more especially the gum; after which, leave it to subside for twenty-four hours. Then decant the ink, and preserve it in bottles of glass or stone ware, well corked.

Many recommend, that the sulphate of iron should be calcined to whiteness. Mr. Desormeaux, jun. an ink manufacturer in Spittalfields, has given the following in the Philosophical Magazine, as the result of much experience: —Boil four ounces of logwood about an hour in six beer quarts of water, adding boiling water from time to time; strain while hot; and when cold, add water enough to make the liquor five quarts. Into this put one pound avoirdup. of blue galls coarsely bruised; four ounces of sulphate of iron calcined to whiteness; three ounces of coarse brown sugar; six ounces of gum-arabic; and one-fourth of an ounce of acetate of copper, triturated with a little of the decoction to a paste, and then thoroughly mixed with the rest. This is to be kept in a bottle uncorked about a fortnight, shaking it twice a-day, after which it may be poured from the dregs, and corked up for use.

Dr. Lewis uses vinegar for his menstruum; and M. Ribaucourt has sulphate of copper among his ingredients. I have found an inconvenience from the use of either, which, though it does not relate to the goodness of the ink, is sufficiently great, in their practical exhibition, to forbid their use. The acid of the vinegar acts so strongly upon the pen, that it very frequently requires mending; and the sulphate of copper has a still more unpleasant effect on the penknife. It seldom happens when a pen requires mending, that the ink is wiped very perfectly from it; and often, when the nib only is to be taken off, it is done without wiping at all. Whenever this is the case, the ink immediately deposits a film of copper upon the knife, and by superior elective attraction of the sulphuric acid, a correspondent portion of the edge of the knife is dissolved, and is by this means rendered incapable of cutting till it has been again set upon the hone.

If a little sugar be added to ink, a copy of the writing may easily be taken off, by laying a sheet of thin unsized paper, damped with a sponge, on the written paper, and passing lightly over it a flat iron very moderately heated.

Inks of other colours may be made from a strong decoction of the ingredients used in dyeing, mixed with a little alum and gum-arabic. For example, a strong decoction of Brazil wood, with as much alum as it can dissolve, and a little gum, forms a good red ink. These processes consist in forming a lake, and retarding its precipitation by the gum.

SYMPATHETIC INKS.

1. Write upon paper with a diluted solution of *muriate of copper;* when dry it will not be visible, but on being warmed before the fire, the writing will become of a beautiful yellow.

2. Write with a solution of *muriate of cobalt,* and the writing, while dry, will not be perceptible; but if held towards the fire, it will then gradually become visible; and if the *muriate of cobalt* be made in the usual way,

the letters will appear of an elegant green colour.

3. Write with *acetate of cobalt*, or with a *muriate of cobalt*, previously purified from the iron which it generally contains. When the writing is become dry, these letters will also be invisible. Warm the paper a little, and the writing will be restored to a beautiful blue.

4. Draw a landscape with Indian ink, and paint the foliage of the vegetables with *muriate of cobalt*, the same as that used in Experiment No. 2., and some of the flowers with *acetate of cobalt*, and others with *muriate of copper*. While this picture is cold, it will appear to be merely an outline of a landscape, or winter scene; but when gently warmed, the trees and flowers will be displayed in their natural colours, which they will preserve only while they continue warm. This may be often repeated.

5. Write with dilute *nitrate of silver*, which when dry will be entirely invisible; hold the paper over a vessel containing *sulphate of ammonia*, and the writing will appear very distinct. The letters will shine with the metallic brilliancy of silver.

6. Write with a solution of *nitrate*, or *acetate of lead*. When the writing is dry it will be invisible. Then having prepared a glass decanter with a little *sulphuret of iron* strewed over the bottom of it, pour a little very *dilute sulphuric acid* upon the *sulphuret*, so as not to wet the mouth of the decanter, and suspend the writing, by means of the glass stopper, within the decanter. By an attention to the paper, the writing will become visible by degrees, as the gas rises from the bottom of the vessel.

7. Write with a weak solution of *sulphate of iron*, let it dry, and it will be invisible. By dipping a feather in *tincture of galls*, and drawing the wet feather over the letters, the writing will be restored and appear black.

8. Write with a similar solution, and when dry wash the letters in the same way with *prussiate of potash*, and they will be restored of a beautiful blue.

9. Write with a solution of *sulphate of copper*, wash as before with *prussiate of potash*, and the writing will be revived of a reddish-brown colour.

10. Write on paper with a solution of *nitrate of bismuth*; when this is dry, the writing will be invisible; but if the paper be exposed to *sulphuretted hydrogen gas*, the words will be distinctly legible.

11. A letter written with a diluted *solution of bismuth* becomes, when dry, illegible; but a feather dipped in a solution of *sulphuret of potash* will instantly blacken the oxide, and revive the writing.—*(Parkes's Chemical Catechism.)*

DR. BLACK'S EXPERIMENT ON CALORIC.

SIR,—I have to thank your correspondent S. P. for purposing a kindness, and in answer to his letter in your 75th Number (page 299), merely to state my objection to the experiment alluded to a little more strikingly: I think he will perceive that it *is* an objection, and an objection which one of his statements goes to support.

"The time in which the water acquires the temperature of the surrounding medium," is not stated in the account I have of the experiment. It is said, however, that "at the end of half an hour it had risen 7° or to the 40th of Fahrenheit's scale, whilst the ice in the other vessel was not melted; its temperature remained at 32°, though it must have received caloric from the surrounding atmosphere *equally* with the other." I think that ice at 32° and water at 40°, would not receive caloric *equally* from an atmosphere at 47°, but that the ice would abstract it with much greater celerity.

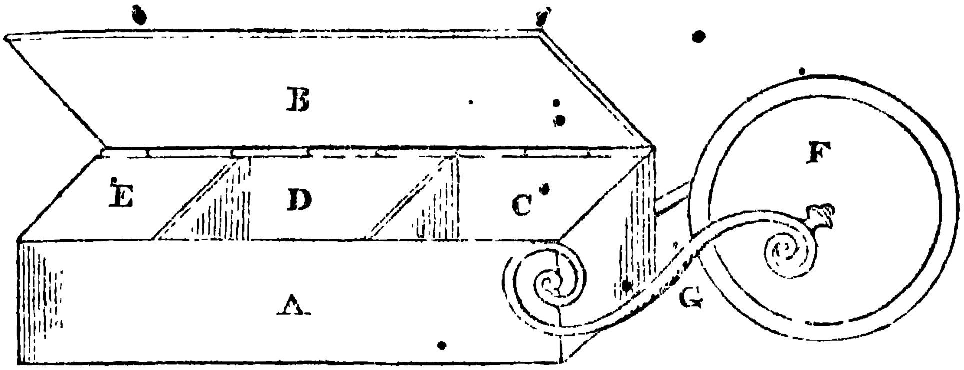
The sensation of cold produced by a body is, of course, proportioned to the celerity with which that body abstracts caloric. Therefore, ice producing a greater sensation of cold than that produced by water at 33°, must, *in the same time*, abstract a greater quantity of caloric. Consequently the rise of temperature in the water cannot indicate the quantity of caloric imbibed by the ice.

The statement I have above alluded to is, "that the difference of sensation perceived on touching ice and water, both at 32°, must arise from the different conducting powers of those bodies." This involves the conclusion that those bodies conduct into themselves, in the same time, different quantities of caloric. A fact evincing it to be impossible to determine the quantity imbibed by one, by that imbibed by the other.

A JUVENILE PHILOSOPHER.

PORTABLE TINDER-BOX.

SIR,—Enclosed is a drawing of what appears to me to be an ingenious contrivance, and which was the invention of a poor American blacksmith, now dead. The improved portable tinder-box, from which the drawing was made, is in the possession of a friend, and may be carried in the pocket, as it is little larger than the drawing.



The box A, with its lid B, is made of tin, but the wheel F is of polished steel. The mode of using it is as follows:—Draw a leathern thong across the axle of the wheel, which causes it to revolve rapidly, and the flint being applied to the edge of the wheel, the sparks which issue from it fall into the tinder-box C, and ignite the tinder, from which a light is procured in the usual way. The division C holds the tinder, D the matches, and E the flint. The wheel is attached to the box by the arms G.

Your obedient servant,
H. W. DEWHURST.

IDENTIGRAPHY.

Mention is made in the Dutch papers of a new discovery in printing, to which the inventor has given the name of *identigraphy*. It consists in a new application of the art of lithography, by which a reprint of common letterpress is obtained in a very short time; the inventor undertaking to reprint the foreign journals within two hours after their arrival by the mail.

SCIENTIFIC LIBRARY AT BOSTON.

A new library is about to be formed in Boston, United States, for the purpose of advancing exclusively the science and the arts. Many of the most distinguished literary and scientific characters of that metropolis, have taken a very active part in the project. From this library are to be excluded all merely literary works, and those also of a miscellaneous character. Every author whose works appertain to the arts and sciences, among which they include commerce and political economy, is to be procured, either from the papers of our own country, or those of foreign lands. *American Paper.*

QUERIES.

No. 58.

WHAT is the best method of preparing water-colours?

T. M.

No. 59.

How to make a silvering powder, or liquid, to silver on tin? Nitrate of silver colours brass or copper, but turns tin black.

A PEWTER-TOY MAKER.

No. 60.

I shall feel much obliged to any of your Correspondents, who can inform me of the method of crystallizing tin of various colours?

A SUBSCRIBER.

No. 61.

Being desirous of constructing an

electrical battery, I should be glad to know the easiest and cheapest method? W. B.

No. 62.

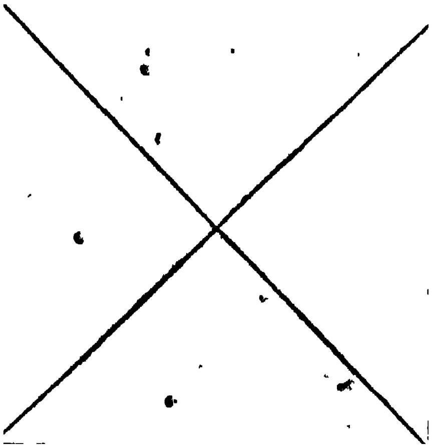
Is there any effectual method of removing spots from prints, without injuring them?

Sophos.

No. 63.

Mr. Editor,—I should feel greatly obliged if you would insert in your excellent Register the under-mentioned proposition: although it seems easy to be solved at first sight, yet I think that, when tried, it will be found more difficult than may be imagined.

I wish to know how, when the fourth part of a square is taken out, as represented in the following figure, the remaining three parts can be divided equally into four parts?



I remain, your obedient servant,
L. S.

No. 64.

Sir,—I shall feel obliged if any of your numerous Correspondents can inform me, through the medium of your highly interesting and valuable Register, how to take black spots out of bronze tea-urns, and also the best method of keeping them, to prevent their spotting?

I am, Sir,
Yours, respectfully,
A Constant Subscriber.
Spital Square.

No. 65.

Sir,—I shall feel much obliged if any of your Correspondents will, through the medium of your valuable work, inform me of the mode of making moulds for plaster medals, and the best materials for this purpose.

Yours, respectfully,
E. H.

No. 66.

Sir,—I shall feel obliged if any of your intelligent friends could inform me which is the best way to prepare paper, for what are called paper frames, for cucumbers, &c.? In A. S. Victor's Query, page 224, Vol. III., he says—"Black or dark colours attract more heat than light ones;" and in Mr. Tatum's First Lecture on Optics, page 282, he says "the dark part of the window-shutters felt hot, while the white was comparatively cold;" and a little lower down, he adds, that "the quantity of grapes was three times greater on the white wall than on the black one; and the quality also much better." Now, Sir, what I want to know is, what oil-colouring will be the best to throw the heat into the frame?

Sir, your constant reader,
W. W.

ANSWER TO QUERY.

Query No. 47. Vol. II. Page 271.

TO PRESERVE BLACK LEAD DRAWINGS.

W. M. is informed, that Black-lead Drawings may be sufficiently preserved by varnishing them with a clear solution of isinglass in water.

H. W. Dewhurst.

TO CORRESPONDENTS.

We regret to state that we are compelled, by unavoidable circumstances, to defer till the next Number our acknowledgments of numerous favours received from our Correspondents during the present week.

THE LONDON
MECHANICS' REGISTER.

"It is an undoubted truth, that the less one has to do, the less time one finds to do it in. One yawns, one procrastinates, one can do it when one will, and, therefore, one seldom does it at all; whereas, those who have a great deal of business, must (to use a vulgar expression) buckle to it; and then they always find time enough to do it in."
CHESTERFIELD.

No. 79.] SATURDAY, MARCH 25, 1826. [Price 3d.

PLAN FOR PRODUCING THE REVOLUTION OF A FLOAT-WHEEL, BY DR. BARKER'S MILL.

Fig 1

Fig 2

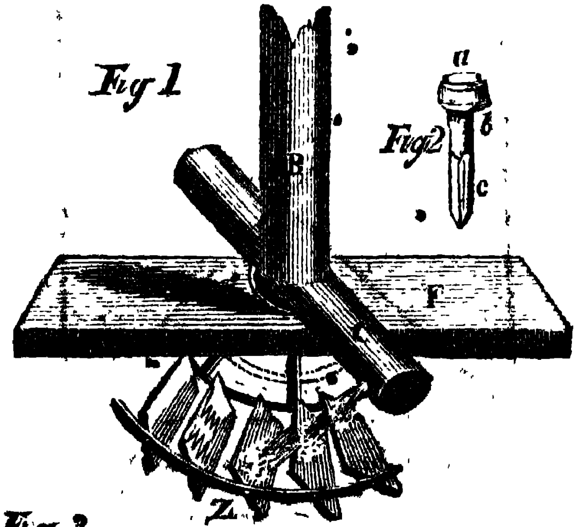
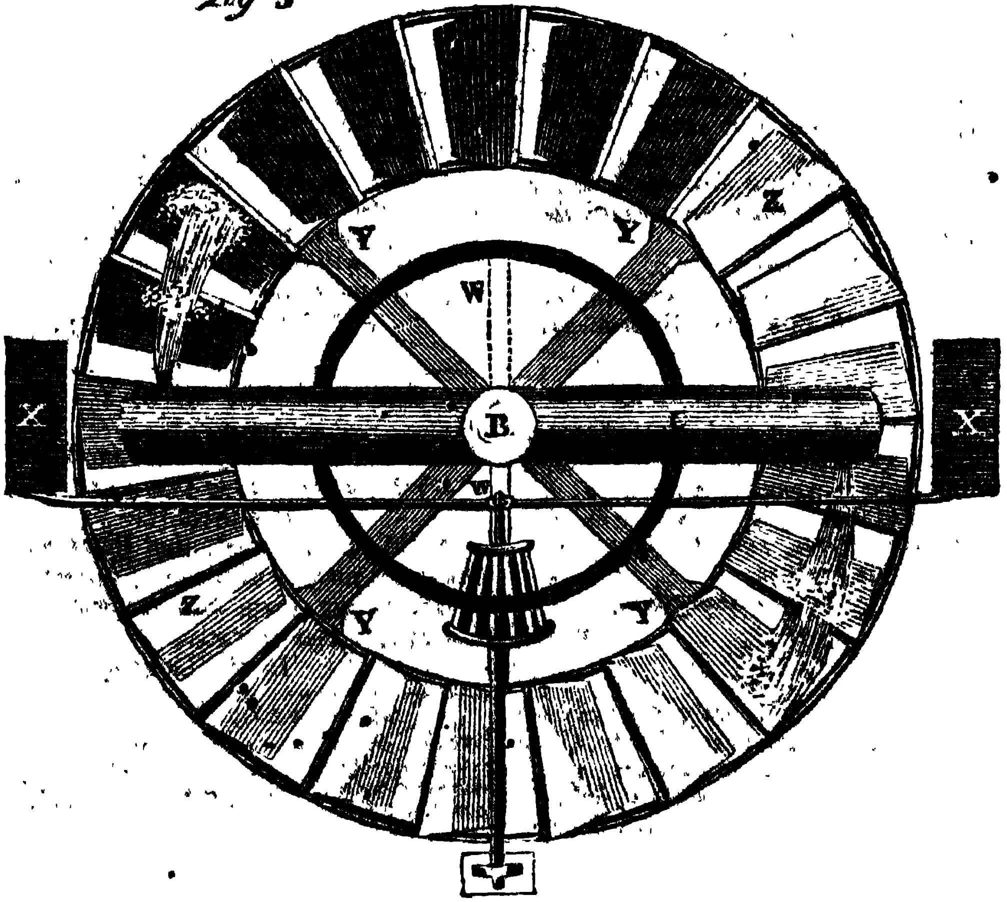


Fig 3



PLAN FOR PRODUCING THE REVOLUTION OF A FLOAT-WHEEL, BY DR. BARKER'S MILL.

To the Editor of the Mechanics' Register.

SIR,—In Ferguson's Lectures with Mr. Partington's notes, page 421, there is a description of Dr. Barker's water-mill, and it appears to me, that, if there were a little addition to the apparatus, its power might be increased very considerably. I propose having a float-wheel, (as Z, fig. 1st) under the trunk C, with the floats inclining sufficiently to cause the wheel to revolve, when the streams from the trunk fall on them, as represented in the same figure. Now we know that the trunk and the float-wheel must revolve in contrary directions to each other, and the axes must both meet in one point. In this case it may be rather difficult to prevent friction; however, I beg to suggest one method, (and perhaps there may be a much better) which is as follows:—suppose we have a strong iron pin (see fig. 2d) with a socket at the top *a*, for the bottom spindle of the upright tube B, and trunk C, to turn in; and the middle of the pin at *b*, to be made round, and pass through the float-wheel; the pin will then serve as an axle for it to turn on; and the bottom of the pin *c* may be made square, and fall into the bridge-tree F, where it would stand firm. Then within the float-boards, (as at the dotted lines) have a circular set with cogs pointing upwards, and on the trunk C, have another circular set with cogs pointing downwards, and a small trundle working between them; so that the power gained by the float-wheel, would be communicated to the upper one, by the trundle. Then in order to obtain places for the axis of the trundle to work in, let a bar pass between the float-wheel and the trunk, and be fastened to the two upright posts; this bar will serve for the inner one; and for the outer one, fix a short post in the ground, or floor. Perhaps my plan may be better understood by fig. 3, which represents the bottom of the mill in a different way. The situation of the cog wheels is shewn by the circular dotted lines; the dotted line W W, are spokes passing from the trunk to the cog-wheel (for the trunk cog-wheel; Y Y Y Y, spokes for the float wheel; and X X, the two upright posts. The other letters refer to the same parts, as in fig. 1st. If, Sir, you should think the above suggestion worthy of any attention, I must beg to refer you to Ferguson's work for a description of the mill, as I am not able to give you a proper sketch of it. *

I remain, Sir,
Your constant Reader,
W. W.

10, *Clift Street, New North Road.*

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* Our readers will find an engraving of Barker's mill, and a description of its operation, in our report of Mr. PARTINGTON's Lectures, Vol. 2, pp. 305, 311, ED.

LONDON MECHANICS' INSTITUTION.

MR. FREND'S FIFTH LECTURE ON GEOGRAPHY.

ANCIENT ASTRONOMICAL OPINIONS — SUPPOSED EFFECT OF THE MOON ON THE WEATHER—DESCRIPTION OF CHINA CONTINUED: ITS POPULATION — CAUSES OF OUR IMPERFECT KNOWLEDGE OF CHINA—EXALTED RANK ATTAINABLE ONLY BY TALENT—MORAL SYSTEM OF CONFUCIUS—ACCOUNT OF HINDOOSTAN: ITS BOUNDARIES, POPULATION, CASTES, GOVERNMENT, &c.—EAST INDIA COMPANY—ARABIA—INCURSIONS OF THE ARABS INTO EUROPE —MAHOMMED—THE JEWS, &c.

WEDNESDAY, MARCH 15TH.

SOME thousands of years ago, observed Mr. Frend, on commencing the present evening's lecture, it was supposed that the earth was immovably fixed in the centre of the universe, and that the sun, the planets, and the stars, all revolved round it once in every 24 hours; and those who opposed this opinion were liable to severe penalties. Its supporters, however, found the greatest difficulty in reconciling the complicated motions of the planets with their hypothesis; but when it was discovered that the earth was not immovable, when the astronomer, in imagination, placed himself in the sun, as the centre of the system, every difficulty was removed, and the motions of the earth, and the planets, were resolved into a system of perfect regularity and harmony.

Now what is true with respect to astronomical observations, is also true with respect to the observations which a man makes upon the rest of mankind. If an individual chooses to make himself the centre of the system, without considering the millions who inhabit the earth as well as himself, and whose manners, religion, and polity may all differ from those of his own country, he must necessarily take a very circumscribed and imperfect view of the subject, and form a very erroneous estimate of mankind in general. To arrive at a correct judgment, continued the Lecturer, you should put yourselves, as it were, out of yourselves, and instead of considering the customs and manners of your own country as a rule for others, you should give to every individual, as well as yourselves, a right to think, to act, and to judge; and though their ideas may be formed upon different models from your own, you will find that all their various habitudes and opinions may conspire to promote the common good, and your own knowledge will be extended by comparing the manners of different countries with each other.

It is a common observation, that when the moon changes, the weather also changes, and we will now examine whether this be true or not. Mr. Frend here turned the globe so as to exhibit in succession the various countries which lie under the same latitude as England, and observed that all these countries are in the same situation with respect to both the sun and the moon as our own island, except as to a difference in the hours. To form a proper judgment, whether the changes of the moon are accompanied by changes in the weather, we should imagine ourselves, like the moon, going round the earth, under the same latitude, in the course of 24 hours, and we should find, in the course of our journey over the different countries, every variety in the barometer and thermometer, and should be convinced that it is a most absurd doctrine, to suppose that changes in the weather are owing to alterations in the phase of the moon, which is, in fact, changing every moment, and not merely at the periods which are generally called the changes of the moon. The Lecturer added, that a friend of his had made constant observations on the barometer and thermometer, and the changes of the weather, for the last 34 years, and had paid particular attention to this very circumstance. The consequence of his remarks was a conviction that the opinion in question had not the slightest foundation in fact. Among the numerous changes which the weather undergoes in our climate, some of them will of course take place at the changes of the moon, but the idea, that the former have any dependence upon the latter, is entirely fallacious.

The moon has been supposed to be the author of other changes, of which the moon-struck madness mentioned by the poets, may be adduced as an example. Even the name of madness, in some languages, is derived from the moon, and this may, perhaps, be accounted for by the circumstance that, in former times, there were no proper places for the reception of insane persons, who were, therefore, suffered to wander about, and might, probably, avail themselves of opportunities of walking abroad by moonlight. The Lecturer, however, was of opinion that the moon had no more to do with madness than with the tides, which, as he had already intimated, he believed to be produced by other causes.

Mr. Frend then proceeded with his description of the empire of **China**, and observed that it was remarkable that all the earliest accounts received of this country, were full of the most exaggerated encomiums on the inhabitants, the wisdom of their laws, &c.; for the philosophers of those days thought that, as the laws and customs of the Chinese differed from our own, they must of course be better. But it was afterwards stated by Lord Anson, that this immense empire, containing 330,000,000 of inhabitants, was actually a nation of *cheats and Atheists!* And why were they considered as a nation of *cheats?* Simply, because some of the followers of Lord Anson were cheated by some of the inhabitants of the coast of China. Now it is possible that persons on board a Chinese vessel might, on arriving at an English port, make a bad bargain with some of our countrymen; but would it be fair to pronounce England a nation of cheats on that account? But it was also said that the Chinese were a nation of *Atheists.* Now, if it were really true that 330,000,000 of people —of people who were capable of building the great wall of China, of constructing numerous and extensive canals; and of accomplishing many other great and laborious works of utility—if it were true that such a people were a nation of atheists, it would be the greatest compliment that could possibly be paid to atheism. But it is not the fact; for the emperor is called the "Son of Heaven," and this appellation could only have been given by those who had some notion of the existence of a heaven. This imputation upon the Chinese originated in the circumstance, that the higher ranks of society in China pay no attention whatever to public worship in the temples, which they consider as being wholly appropriated to the use of the lower classes.

We are still, in a great measure, ignorant of the real state of this populous and extensive nation, and our want of information is attributable, first, to the Chinese, and, secondly, to ourselves.

In the first place, the Chinese, owing to a national prejudice, have a great dislike to the introduction of foreigners, from an apprehension that they may corrupt the manners of the people. Foreigners, therefore, who have travelled into the interior of China (as in the case of our own embassies to that country), have been obliged to proceed straight forward to the place of their destination, without being suffered to go out of the road, to the right or to the left, to make those discoveries which would have enabled them to form a just estimate of the country and its inhabitants.

In the next place, it is well known that a great commercial company in this kingdom carry on a very extensive trade with China in the article of tea; but all the agents of the Company who reside in China, are confined to a very small portion of the country, and such is the wisdom of our legislators, that no Englishman can visit China, except under the auspices of this company. Englishmen, therefore, generally speaking are precluded from going to China, as they would be enabled to do if there were a free commercial intercourse between the two countries; and what knowledge of China can we expect to obtain from a few clerks, residing merely on the confines of the empire? Suppose a number of Chinese clerks were sent to England, but were allowed to come no further than the Scilly Islands, what information would they be able to communicate to their employers respecting the inhabitants of England? yet such is exactly the situation in which we stand with respect to China.

There is one very remarkable circumstance connected with China which deserves particular notice. A book has been exhibited in the written language of the Chinese, and it must be observed that it is impossible to make any great progress in the knowledge of this language without intense study and indefatigable perseverance. The highest offices in the state are open to every individual in the empire, whatever be his rank in society; and if a man possess talent, however low his situation in life may be, he must infallibly rise to eminence. The Chinese written language consists of about 80,000 words, and a periodical examination takes place of the proficiency of the inhabitants in their knowledge of these words, and the books of Chinese literature. If it should appear that an individual has made a certain degree of progress, his talents are rewarded by promoting him to the rank of a mandarin of the lowest class. At subsequent examinations, his further improvement advances him still higher, till he reaches, progressively, the high est employments in the state.

In this country, the possessor of 50,000*l*. or 100,000*l*. considers himself entitled to the respect which is generally paid to him on account of his property; but in China, the question is not how much property does a man possess, but how many words is he acquainted with? The people in that country pay no respect to the possessor of 100,000*l*., or of a million of money (and there are such persons in China), except he possesses those talents upon which alone his rank in society depends. Whether the Chinese practice, continued Mr. Frend, be superior or inferior to our own in this particular, is a point which I do not pretend to decide, but must leave entirely to your own consideration.

The Chinese have no such thing as an established religion; every one being left to his own way of thinking. The priests must, therefore, depend entirely upon the people, and no man of real talent will ever enter the priesthood; an office which is confined to the observance of mere ceremonies, while the possession of talent, and an acquaintance with literature, will raise any individual to the most exalted rank in society.

Three or four hundred years before the Christian era, an extraordinary man, named Confucius, arose in China, who laid down a system of religion and morals upon which the Chinese have ever since acted, and the basis of this system was *self-esteem.* His opinion was, that every man should consider himself abstracted from all other men, and that he should esteem himself in proportion as he acted upon his own ideas of what was right or wrong, worthy or unworthy. From this general principle he drew the following conclusion:—that he who esteemed himself in this manner, would esteem all around him; and that the more men esteemed themselves, the more they would esteem each other.

To sum up the whole in a few words, it may be observed, that the empire of China differs from our own country in many important particulars. According to the Chinese system of government the emperor possesses immense power, but this power is restrained by custom. There is a class of learned men, who are completely distinguished from the vulgar by their attainments; but there are no nobility, nor any established clergy in the empire. Possessions in land or money confer no consequence on the possessors, and the country shews the most evident proofs of the ability and industry of its inhabitants, as exhibited in their roads, canals, bridges, and other works of public utility, of the most splendid description. In short, however China may differ from England in the manners and customs of its inhabitants, there are many circumstances peculiar to the Chinese, from which we might extract hints for our own improvement.

The next country of Asia, to which Mr. Frend directed the attention of his hearers, was the extensive territory called HINDOOSTAN. This country is inhabited by a race of men, differing materially from the Chinese in their general appearance, manners, and customs; yet exhibiting marks of excellence in many particulars. Hindoostan is bounded on the East by the Bay of Bengal, and on the West by the Arabian Sea and the river Indus, which penetrates into central Asia. The Boorompooler and the Ganges rivers separate it from the rest of Asia on the North, and its Southern extremity terminates in a cape reaching to the Indian Ocean. This immense country is inferior to China in population, but contains about 100,000,000 of inhabitants. Little was known of Hindoostan till the 15th century, when the Portuguese, under Vasco de Gama, sailed round the Cape of Good Hope, and made inroads into the country. It was successively subjugated by the Portuguese, the Spaniards, the Dutch, and the Danes, till at last a great portion of this extensive region fell under the dominion of England in a most extraordinary manner. The ancients were acquainted with this part of the world, which they mention as a place where the inhabitants abstained from animal food, and believed in the transmigration of souls. Pythagoras travelled into this country, and brought back notions which would not suit us in the Northern climate which we inhabit.

Hindoostan is not of so great antiquity as China, though the books of that country are of very remote date, and trace its history from a period a thousand years before our era. The *Vedas*, or sacred books of the Hindoos, are written in a language now obsolete, and as it requires great study to understand them, they are read only by the learned.

It is a remarkable circumstance, that the inhabitants of this vast country are divided into *casts*, and that no individual born in one cast can ever get into another. In England, a man of the humblest rank in society may become a nobleman; but, in Hindoostan, whoever has the misfortune to be born a *Parear*, or outcast, must always remain so. No abilities, talents or exertions can ever advance him to the rank of a *Bramin*, which is the highest cast. Such indeed is the distinction between the highest and the lowest casts, that a *Bramin* would think himself contaminated by coming in contact with a *Parear*. Distinctions like these are certainly contrary to nature, and it would be of great advantage to the country if they could be abolished. The *Bramins* are supposed to derive their origin from the great God *Brahma*, and are, therefore, treated with the highest respect and deference.

Among the Hindoos, religion is carried to an extent scarcely credible. They worship the Trinity under the names of *Brahma*, *Vishnoo* and *Sheeva*, but under these Gods there are hundreds of inferior deities; all of them having traditions attached to them, many of which are very amusing. The religious temples of the Hindoos are very magnificent, particularly one, which is dedicated to the idol Jaggernaut; and such is the lamentable superstition of the people, that many of them actually throw themselves under the wheels of the idol's chariot, and think themselves happy that they can expiate their sins by such a death.

The government of this immense region is of so singular a nature, that the ancients could never have contemplated the possibility of its existence. And where is the magnificent palace occupied by the rulers of such a vast territory? Every one of you, continued the Lecturer, has passed by it, and has seen this splendid palace in Leadenhall Street (*Laughter*). The powerful princes who govern Hindoostan are the 24 Directors of the East India Company, and the mode in which this government was acquired, was of a most extraordinary nature. A few merchants went over and established themselves in one little spot: another party of merchants fixed themselves in another little spot, and so on, till the English settlers became numerous. Then they contrived to set the native princes fighting with each other, and by fomenting these wars, increased their own ascendancy. A governor was then sent out from England, who reigned in India with a degree of splendour which vied with that of his own sovereign, and Hindoostan at length became subjected to the power of a company of English merchants.

All this appears very extraordinary, said Mr. FREND, and I can hardly conceive any scene more curious than would be exhibited, if one of the Rajahs of India, in all the pomp of Eastern royalty, were to visit England, for the purpose of paying his respects to the vast power by which he is himself governed. And where would he find the representative of the power which rules the destinies of a hundred millions of men?—Not seated upon a royal throne, but standing, with a small desk before him, and a hammer in his hand, knocking down a lot of tea to the highest bidder! (*Loud laughter.*)

This may appear rather ludicrous, but the subject should be examined in another point of view. Hindoostan has been, at various periods, under different governments; it has been conquered by the Arabs, the Tartars and others, but it was never so well governed as since it has been under the dominion of its present rulers. The inhabitants now enjoy such comforts and advantages as they never experienced under any other form of government, and the fact is highly creditable to those who govern them.

But notwithstanding the advantages the Hindoos possess under this government, there are studious and learned men among them who are deeply sensible of their dependant situation. As a proof of this, the Lecturer related a very interesting anecdote of a relation of his own, a General in the India service, who was conversing with a *Bramin*, on the nature of the government, when a hawk happened to pounce upon a dove, and the *Bramin* asked the General which was the best bird of the two? "You," said he, "are the hawk, and we are the dove. It is the will of Brahma that you should keep us in subjection; but the time will come when the claws of the hawk will be cut and his wings will be clipped, and the dove will be enabled to live in tranquillity."

ARABIA is another extensive Asiatic nation, the characteristics of which differ widely from those of the countries already noticed. China is abundantly supplied with water from numerous rivers and canals, and is extremely populous, while Arabia consists, for the most part, of an immense sandy desart, and its inhabitants are few in number. Arabia is nearly surrounded on the East, South and West by the Red Sea, the Arabian Sea, and the Persian Gulf, and on the North, it communicates with Persia and the Asiatic dominions of Turkey. The inhabitants of Arabia boast that they never were conquered, for it appears by historical accounts, that though the country has been passed over at different times by foreign invaders, they never kept possession of it, and for a very good reason—because it was not worth keeping. Yet in this desart region are the remains of a city, which, from the numerous pillars, shafts, and other architectural vestiges which have been discovered, gives indubitable proofs of great proficiency in the arts at a very early period. A city of such extent and magnificence could not have existed without some cooperating causes, and it is highly probable that this place was the great entrepôt of the commerce carried on between Arabia, Syria, Hindoostan and Europe.

Arabia, about 1100 years ago, made itself known to every part of the world by the extraordinary efforts of a set of fanatics, who rushed from the bosom of this desart region, and extended their conquests over Persia and other countries in Asia, and after subjugating all the Northern parts of Africa, crossed into Spain and reached the Pyrenees, when, happily for mankind, their progress was arrested by Charles Martel, who drove them back into Spain, which remained under their dominion. It is certainly an extraordinary circumstance in the history of nations, that the talents of a single individual, the celebrated MAHOM-

MED, should have enabled him to lead the inhabitants of a sandy desart from the heart of Arabia; and that, animated by a spirit of enthusiasm, and the hope of plunder, they should have succeeded in devastating great part of Asia, Africa, and Europe; yet, under the dominion of these people, knowledge flourished in the nations which they subjugated; for while all the rest of the earth was in darkness, the Arabians were enlightened by science, and they distinguished themselves as much by their superior intelligence as by the success of their arms.

Mr. Frend finally adverted to the JEWS, whose nation also sprung from this desart country, and who, under the guidance of a great legislator, formed a code of laws which was received with admiration by all nations. It was remarkable that two millions of people should accept the constitution given to them by universal suffrage; yet such was the case, and their system of legislation, owing to the just principles upon which it was founded, was conducted with the greatest order and regularity. One part of this system was adopted in our own country by Alfred, in his division of the kingdom into tenths, hundredths, thousandths, &c.; and the vestiges of this plan still exist in the names of those portions of the country which are called *hundreds*, *tythings*, &c. But this subject, concluded the Lecturer, would occupy too much time, if I were to enter upon it this evening, and therefore, for the present, I must take my leave.

MR. TATUM'S FOURTH LECTURE ON ELECTRICITY.

QUADRANT ELECTROMETER — ELECTRICITY PRODUCED BY EVAPORATION— ATMOSPHERICAL ELECTRICITY—THUNDER—POSITIVE AND NEGATIVE ELECTRICITY PRODUCED BY THE SAME SUBSTANCE—MEDICAL ELECTRICITY— COMMUNICATION OF THE ELECTRIC SHOCK.

FRIDAY, MARCH 17TH.

MR. TATUM commenced his discourse, according to his usual practice, by adverting to the principal points illustrated in his previous lecture, after which he exhibited the operation of the *quadrant electrometer*, as a further illustration of his argument, that electrometers are measurers of *intensity* and not of *quantity*. He first charged an ordinary jar with which the quadrant electrometer was connected, till the index reached 14 degrees. This was effected by 25 turns of the machine; but when a very large jar was charged, it required 52 turns to raise the index to the same point. In the latter case, the *quantity* of electricity was evidently more than twice as great as in the former, though the degree of intensity to which the jar was charged, was the same. It was therefore evident, that this electrometer, like the others, measures the *intensity* of the charge, but not the *quantity* of electricity elicited during the operation of charging the jar.

The Lecturer next directed the attention of the audience to the signs of electricity produced by the evaporation of water, which, he observed, was a chemical process, during which, the water entered into combination with *caloric*, or *heat*. The effect is the same whether the evaporation is produced quickly, or takes place slowly, as moisture evaporates from the earth. Now, when water is converted into vapour, its capacity for electricity is increased, and it will therefore take up a portion of electricity from the body with which it was in contact, and become in a redundant state; consequently, as water is evaporated from the surface of the earth, a considerable portion of electricity will be abstracted from the earth and carried up with it; and when the aqueous vapour is again condensed into water, its capacity for electricity being then decreased, the electric fluid will be given out, and this fact may account for the violent rain which frequently occurs during a thunder-storm.

Mr. Tatum exemplified his remarks on this subject by an experiment, to which we have alluded on former occasions, and which is performed by placing a piece of red-hot metal in a kind of dish on the cap of the electroter, and dropping water upon it, by which means a copious evaporation is produced. (Vide Vol. I. p. 75.) This experiment is of a very delicate and capricious nature, and in the present instance, was attempted three or four times before it succeeded; but the gold leaves of the electrometer at last diverged in a very decided manner, and the signs of electricity resulting from the process of evaporation were rendered very evident. Mr. Tatum remarked that it was, no doubt, unpleasant to an audience to see an experiment fail, but it was much more so to a Lecturer. It was, however, sometimes necessary to exercise a little perseverance, and in the present instance it had succeeded, for the gold leaves had ultimately diverged to a very considerable extent. Now, if the comparatively trifling evaporation produced in this experiment, elicits sufficient electricity to cause the gold leaves to diverge, how much greater must be the effect of the constant evaporation from the surface of the earth, which must necessarily carry up large quantities of the electric fluid. The Lecturer added, that he had always found the atmospere in a *positive*, but never in a *negative* state of electricity; and that, during a thunder storm, the *earth* may be conceived to represent the *exterior*, and the *atmosphere* the *interior* of a jar. When, therefore, a clap of thunder is heard, the discharge of this imaginary jar takes place, and the *redundant* electricity of the atmosphere is restored to the earth to supply its *deficiency*.

Mr. Tatum then shewed that the friction of brown paper with woollen cloth, by passing it quickly under the arm, causes it to exhibit signs of electricity when presented to the electrometer; and he stated, that the friction of Indian rubber with writing-paper has a similar effect; the only difference being, that the brown paper produces signs of *negative*, and the white paper of *positive* electricity.

Some electrical authors have stated that there are *negative* and *positive* electrics, but the Lecturer considered it impossible to say that this body was a *positive*, or that a *negative* electric; for the state of electricity in any substance depends upon its degree of affinity for the electric fluid. Thus, sealing-wax, when excited by *fur*, becomes *negatively* electrified, because the fur has the greatest affinity for the electric fluid; but if the same substance be excited by friction with *tinfoil*, it will be *positively* electrified, because the tinfoil possesses less affinity for electricity than the sealing-wax does. It is evident, therefore, that the same substance may be made to exhibit signs of either *positive* or *negative* electricity.

Medical electricity was the next branch of the science to which Mr. Tatum adverted, but as we have already had occasion to particularize all the various modes in which electricity is applied for medical purposes, it is unnecessary for us to repeat them. (Vide Vol. II. p. 116.) One of the Members, at the invitation of the Lecturer, was kind enough to step forward to the platform, in order to afford him an opportunity of exemplifying the medical application of electricity.

Mr. Tatum concluded, by redeeming the pledge he had given in his previous lecture, to communicate the electric shock to a considerable number of the Members at once. For this purpose, the Members occupying the three first rows of the gallery were requested to join hands, and a jar having been charged, a communication was formed between the first and last Members of the series, and the exterior and interior of the jar. The jar was then discharged, and the effect produced by the electric fluid passing through so many individuals at the same moment, was laughable in the extreme. An involuntary Oh! burst from several of the Lecturer's *patients*, and was answered by reiterated peals of laughter from the rest of the numerous assembly. The operation was repeated in the Pit, with the same ludicrous effect, and the audience departed in the highest good humour.

LECTURES FOR NEXT WEEK.

Wednesday, March 29, and Friday, March 31, Mr. TATUM'S Seventh and Eighth Lectures on Electricity, which will conclude the course.

EFFECTS OF CARBONIC ACID GAS ON THE ATMOSPHERE.

To the Editor of the Mechanics' Register.

SIR,—Your correspondent F. C. in your 77th No. (page 329,) seems to have pleaded hard and successfully for the honour (as he supposes it) of having the last word on this subject; and as I had, on a former occasion, professed my intention to take leave of it, this gentleman expected, no doubt, to have the pleasure of quietly walking over the course by himself—an honour he assuredly might have enjoyed in all its plenitude, had he acted fairly and honourably in his statements. But notwithstanding the apparent mildness in the gentleman's strain, and there is certainly much improvement in that respect, "C'est drôle de voir l'ennemi toujours caché au fond."

When a person quotes from another, with a view to found an argument upon it, should not that quotation be correctly given? Assuredly it ought. But what has F. C. done in this instance? He has made a garbled statement of what I said, leaving out of it entirely that part to which the subject in question refers, and which, by that means, bears him out in his conclusions. My words from which he quotes were, "that but for lime-kilns, cities, '*in our moist climate*,' would scarcely be habitable." But F. C. by omitting the words "*in our moist climate*," leaves out the only place where such effect would be produced; and his reason for doing so is obvious, as there are hundreds of cities differently situated, and some of those among the healthiest in Europe, without such an appendage as a lime-kiln in their vicinity.

F. C. has given several quotations from Sir H. Davy, the greater part of which are intended to shew, that growing plants absorb *carbonic acid gas*—a fact which nobody disputed; but as he says, "that they cannot fail to prove highly instructive to those who have not read the works from which they are selected," there can be no objection to their being afforded for that purpose. One of these quotations, however, and one only, I allow, bears upon a point of difference between F. C. and myself, and, if correct, would be decisive of it in his favour, which says, "that there is no other process known in nature, by which *carbonic acid gas* can be destroyed but by vegetation." But notwithstanding the great authority here given, and I allow it to have great weight, yet human wisdom is not infallible, and that great chemist himself would be the last to require an implicit surrender of the judgment of another without conviction. Had the words been so qualified as to state, that it was the *principal process* known for destroying *carbonic acid gas*, I could readily subscribe to it, but before I consent to its being the *only one*, it must be first explained to me how the numerous class termed *carbonates* had their existence, if not from a similar source. Even the soil is known to be highly charged with it, as well as numerous springs, and I think there is little doubt that it is from these sources plants derive their principal supply, as the small quantity of it existing in the atmosphere (which undergoes little variation) would seem to be inadequate to afford it.

Saussure, on examining the residual matter termed *vegetable mould*, found it nearly all composed of *carbonaceous matter*, unsusceptible of being acted on by the putrefactive process, which shews how necessary it is, that the mould should be frequently turned up, and exposed to the action of *oxygen* in air and moisture, in order to be converted into *carbonic acid gas*, and afford a proper manure to the growing plants. As all soils are more or less valuable according to the quantity they afford of this gas, is it unreasonable to suppose that other earths may absorb it, whenever it is set at liberty, and so be converted into productive soil, serving as a reservoir to retain it for the wants of vegetation?

The specific gravity of this gas when liberated, causes it to remain close to the surface of the ground, which is evidently a contrivance of nature to retain it where it is most wanted, as it is unfit for the respiration of animals. But on a former occasion, I have shewn that the *alkaline earths* readily absorb it from the atmosphere; that upon this principle cements are formed, and that to it is owing the binding quality which the mortar possesses, with which our habitations are built. And if I prove the fact of one exception, it is as good as twenty, to overturn the doctrine contended for.

There is still remaining a material point, Mr. Editor, on which I should wish to make a few observations, as it has occurred to me lately, that I have been misunderstood on it by your correspondent, F. C., and that it is to this probably, I, in some degree, owe the opposition manifested by him. When I stated, as he quotes, "that the air was oftener deteriorated by excess of *oxygen*, than by *fixed air*," I did not by this mean *oxygen* in its pure and uncombined state, but as it is afforded from moisture in the atmosphere, (water yielding it in the proportion of about 85 per cent.) being that to which all my arguments referred. As a proof that water parts with it more readily than the air, take any one of the oxidable metals, for example; let its surface be polished, and if it be then exposed in a perfectly *dry* air, no change whatever will take place, but in a *moist* air it will speedily become oxidated. The important agency of *oxygen* in effecting the decomposition of animal and vegetable bodies, I have before pointed out; and on all such occasions, heat and moisture are found necessary, the potency of the sun's rays accelerating the decomposition. In all cases it will be found, where the air has become bad and unhealthy, the cause may be traced to the operation of these two, and whence arises the saying, " a damp unhealthy climate." The noxious effluvia arising from standing pools, marshes, &c. which poison the air, shew this effect in full operation; but even in situations where these vapours have not contaminated the air, a humid atmosphere is injurious to the human frame, from the excess of *oxygen* it affords, when taken in by the lungs, occasioning fevers, and a long list of inflammatory disorders. In all combinations with *oxygen*, an increase of temperature takes place; from this source, it is supposed, our animal heat is derived, and hence the term *vital air* given to it, soon after its first discovery. Containing, as it does, so great a principle of vitality, F. C. contends that no excess of it can be injurious, which is one of the points we differ upon, although it has been shown so stimulating, as to cause a more rapid circulation of the blood, marked by an increased pulsation, and to affect the brain to such a degree, as to occasion a perfect delirium, during the short period it can be inhaled, and that animals confined in it have been known to die, not from the gas having been expended, (as F. C. once insinuated) for another animal placed in the residual air, has been found to live.

To sum up the whole, then, if I find those effects produced by a humid atmosphere, on account of the *oxygen* it yields to effect the work of decomposition, and that, on the other hand, *carbonic acid gas* is the most powerful antiseptic known, for checking the putrefactive process, I think I have made out my case; and that lime-kilns, in consequence of the *fixed air* they give out, so far from being prejudicial, are beneficial in counteracting the effects of a humid atmosphere.

Let me assure F. C., however, that I am not so far wedded to this opinion, as to be lost to conviction, if the contrary can be shewn. If he, therefore, can throw any light upon the subject which shall make it clear that I am in error, let him do so. But let him not misrepresent what I have said, and then turn round and say, " these are grossly erroneous notions."—I have the pleasure to remain,

Your very obedient Servant,

S. C. GMO. HENRICUS.

UTILITY OF BOTANICAL STUDIES.

To the Editor of the Mechanics' Register.

SIR,—Now that the season for commencing the study of that delightful and useful science, Botany, is arrived, I take this as the best opportunity to direct the attention of your readers to the subject, in order that they may be induced to devote a little time to a study which will afford the greatest amusement and delight, and add double gratification to their summer excursions. If either of your readers, unacquainted with the subject, knew but a small part of the pleasure experienced by a botanist, upon finding a plant he has long sought after, the associations connected with a simple flower, or how by turning over his *herbarium*, and finding plants collected from every country in which he has travelled, he is enabled to recal to his recollection the romantic spots upon which they grew, he would need no other inducement to the pursuit of Botany: yet these fruitful sources of pleasure are but a small part of the gratifications connected with a study of the vegetable kingdom. Add to this abundant and ever varying amusement the utility of a knowledge of so great a division of the works of nature, independent of its religious and moral use, it teaches us many important facts relative to the means of satisfying our bodily wants and increasing our worldly enjoyments—it shows how to distinguish such plants and trees as are adapted for food or medicine, for building, for clothing, and the many purposes of utility, luxury and ornament to which they may be applied.

The study of this science is besides

exceedingly easy, it requires no expensive apparatus either for experiment or illustration; a strong magnifying glass and 2 or 3 books being all that are necesssary. No laborious study, no violent exertion of body or mind is requisite to the botanist, a little care and attention only is required, while the pleasure is no less at the commencement than during our further progress in botanical pursuits. It may be supposed that Londoners have not an opportunity of collecting specimens of flowers; but nothing is more erroneous than such a supposition; for the metropolis is surrounded with places which afford ample means for the botanist to gratify his inclination. For instance, most of the *water-plants* may be found either on the banks of the Thames between Richmond and London or on the River Lee. Hampstead Heath and its neighbourhood produce many curious specimens, as several of the *ferns*, *spleenwort*, *polipody* and the *sundew*. The vicinity of Sydenham and Norwood abounds with a great variety of woody plants, while Epping and Hainault forests produce several of the *orchises*, *heaths*, &c. &c. Many plants which, from the distance from London of the places where they are found, cannot be so easily gathered, may be procured in great perfection at our herb shops. Many other indigenous plants are also cultivated in our gardens, as *thrift*, *London pride*, *saxafrage*, &c. &c. &c. For the collection of those plants which grow upon chalky or sandy soil as well as the sea plants, he must take advantage of his water excursions to the Nore, Margate, &c.—when he may very easily fill his sandwich-box with food for the mind, instead of the savoury viands it was made to contain. These are not all the resources which a young botanist may avail himself of, but they are amply sufficient to ensure a very considerable acquaintance with British Botany.

I would now give the young student some plain, easy and practical hints to direct his pursuits in this delightful science, were I not fearful of trespassing too much upon your pages: this then must form the subject of another letter, which shall be sent immediately upon any intimation from you, sir, that it would be likely to prove acceptable to your readers. In the mean time I would recommend to their notice that part of Mr. Wheeler's lectures relative to the names and distinction of the classes and orders.

It will I trust be remarked, that I have not in these few observations at all interfered with the object of **Tyro**, inserted in your late numbers; but particularly request that gentleman to continue his valuable letters, hoping they will meet with that attention to which they are so well entitled.

Francis, jun.

VENETIAN BLINDS.

To the Editor of the Mechanics' Register.

Sir,—Oftentimes, when writing or reading, I have felt the light, as it came horizontally, rather painful to my eyes. I believe we all prefer a descending light. To obtain relief, I have lowered a Venetian blind to the cill of the window, and so turned it as to darken the room. I have then reversed about six or eight of the upper laths, so as to admit a sufficiency of light, which falling in nearly perpendicular rays upon what I might have before me, came to my eyes mildly and agreeably reflected. I think *Venetian blinds* might be easily constructed so as to be lowered at top after the bottom lath has been let down. This would effect more completely what I do by placing the upper laths with the inner edge downward to admit light, and the lower laths with the inner edge upward to exclude light. The thick top lath, which turns on two or three swivels, and supports and regulates all the other laths, might have lines attached to it for the purpose of being lowered, and might still perform the very same office it now does. I throw out this hint to my brother mechanics, who are blind makers, and shall be very happy to impart the result of my meditation upon this subject.

Artists generally close the lower part of the window-shutters for the sake of a descending light. I think, among others, they would be purchasers of this sort of blinds.

Yours respectfully,

Deptford. J. P.

SAFETY FOR LOADED FIRE-ARMS.

SIR,—From the frequency of accidents arising from persons incautiously handling loaded fire-arms, I hope you will not consider the following suggestion unworthy of a place in your pages.

Let every person on loading any piece, which he intends to keep by him in that state, fasten to the trigger a card having the word "LOADED" on it, in legible characters. He might also, for his own information, add the contents of the charge, and the date when it was loaded.

If any person was to take up a piece so guarded, they would be cautioned by the card, and it is to be hoped, all danger would be prevented. Gunsmiths might have cards printed for this purpose, which I have no doubt would meet a ready sale.

Yours respectfully,
W. B. jun.

March 15, 1826.
No 10, *George-yard, Lombard-street.*

HUMMING BIRDS.

"THE climate of the Brazils is delightful to a proverb; and the entrance into the harbour of Rio Janeiro is said to be even more magnificent than that of Constantinople. The landscapes of the Brazils derive additional charms from the quivering of the Humming Bird, the hues of which are the richest in creation, and are continually varying in different lights. The Indians call them 'sun-beams;' their nests hang at the end of the twigs of oranges, citron, pomegranate, and other odoriferous trees. Such is the bird that gives life to every shrub and flower in many parts of South America; while in Africa, the Creeper, a bird of brilliant plumage, flutters from blossom to blossom, and sitting on the edges of the corollas, sips the honey from mellifera, and warbles in a most delightful manner."—*Humboldt's Personal Narrative.*

ANSWERS TO QUERIES.

QUERY, No. 42, Page 240.

BRANDY AND WATER QUESTION.

SIR,—Thinking I have discovered a shorter method of answering the Brandy and Water question of G. Morley, than that offered by L. B. W., I hope the liberty which I am taking in intruding it in your valuable paper will be excused. The answer is worked by geometrical progression.

I remain, Sir,
Yours respectfully,
J. G. H.

Brandy taken out.

$$\left.\begin{array}{lr} \text{First Term} & 1 \\ \text{Ratio} & \frac{9}{10} \\ \text{No. of Terms} & 10 \end{array}\right\} \qquad \begin{array}{r} \left(\frac{9}{10}\right)^{10} = .3486784401 \\ 1 - .3486784401 = .6513215599 \\ 1 \\ \hline 1 - \frac{9}{10} = .1\ \big)\ .6513215599 \\ \hline 6.513215599 \\ \hline\hline \end{array}$$

Brandy left in.

$$\left.\begin{array}{lr} \text{First Term} & 10 \\ \text{Ratio} & \frac{9}{10} \\ \text{No. of Terms} & 11 \end{array}\right\} \qquad \begin{array}{r} \left(\frac{9}{10}\right)^{10} = .3486784401 \\ 10 \\ \hline 3.486784401 \\ 6.513215599 \\ \hline 10.000000000 \text{ Gallons.} \\ \hline\hline \end{array}$$

QUERY, No. 42, Page 240.

BRANDY AND WATER QUESTION.

SIR,—The solution of the Brandy and Water question inserted in No. 75, p. 303, of your Register, though *correct*, and neatly performed, is only a solution to that *particular* question; and, consequently, a very *partial* one. This, however, is not the sort of solution required, I conceive, by the proposer, who, perhaps, would prefer an algebraical one; and, as in *general solutions*, all the particular cases are included, I have been induced to offer you the following, derived from general principles; leaving to your discretion the propriety of inserting it.

I am, Sir,
Your obedient servant,
A Member of the Spitalfields Mechanics' Institution.

General Solution to the Brandy and Water Question.

Let a = the contents of the vessel, $\frac{1}{n}$ = the part withdrawn, and m the number of draughts.

Then $\frac{a}{n}$ = the first draught, and $a - \frac{a}{n} = \frac{na-a}{n}$ = what remains. $\frac{na-a}{n^2}$ = 2d ditto, and $\frac{na-a}{n} - \frac{na-a}{n^2} = \frac{a(n^2-2n+1)}{n^2} = a\left(\frac{n-1}{n}\right)^2$ = 2d remainder.

$\frac{a(n^2-2n+1)}{n^3}$ = 3d ditto, and $\frac{a(n^2-2n+1)}{n^2} - \frac{a(n^2-2n+1)}{n^3} = \frac{a(n^3-3n^2+3n-1)}{n^3}$ $= a\left(\frac{n-1}{n}\right)^3$ = 3d remainder.

$\frac{a(n^3-3n^2+3n-1)}{n^4}$ = 4th ditto, and $\frac{a(n^3-3n^2+3n-1)}{n^3} - \frac{a(n^3-3n^2+3n-1)}{n^4} =$ $\frac{a(n^4-4n^3+6n^2-4n+1)}{n^4} = a\left(\frac{n-1}{n}\right)^4$ = 4th remainder.

Here the law of the series is sufficiently manifest; hence the quantity of brandy remaining after m draughts $= a\left(\frac{n-1}{n}\right)^m$. In the present case, $a = 10$, $n = 10$, and $m = 10$. $\therefore a\left(\frac{n-1}{n}\right)^m = 10 \times \frac{9}{10}\Big)^{10} = 3,486784401$; and hence the water = 6,513215599.

The formulæ here deduced will apply to any similar question; whatever be the contents of the vessel, the number of draughts, or the quantity drawn each time.

QUERY No. 48, Page 271.

BLUEING OR COLOURING STEEL.

IN answer to a Constant Reader, who wishes to know what is the method, at present in use, for colouring, or blueing, of steel, I beg to state that the method which I use, and which I think is as simple and easy as any, is as follows. I have a pan made of thin sheet brass, into which I put, evenly, some clean brass filings, and warm them for fear of damp, to dry them, I then lay on my steel, which must be first perfectly polished, and hold it over a gentle heat; for small things, I generally use a candle, and in a short time the article becomes a fine blue, which I do not touch till cold.

J. S. 6.

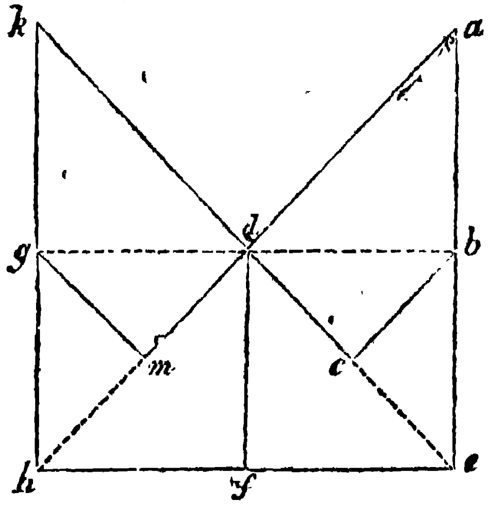
QUERY No. 63. Page 352.

DIVISION OF THREE FOURTHS OF A SQUARE.

SIR,—I beg to offer the following answer to the 63rd question in your last Register. Let the three-fourths of a square be represented by *khea*, draw the lines *gb* and *df*, and we have six right-angled triangles *kgd*, *ghd*, *hfd*, *fde*, *dbe*, *dba*, each equal to the other. Upon the diagonal *ha* draw the perpendicular *gm*, and the triangle *hgd* will be divided into two equal parts *ghm* and *gmd*. Now since the triangle *kgd* is equal to the triangle *hdf*, and *ghm* is equal to *gmd*, *kgmd* is equal to *ghfd*. And by reasoning in the same manner, it is shewn, that *dfeb* is equal to *dcba*; therefore, the three-fourths of the square are divided into four equal parts, *kgmd*, *ghfd*, *dfeb*, *dcba*.

I am, Sir, yours, &c.
M. W.

Fenchurch-street.

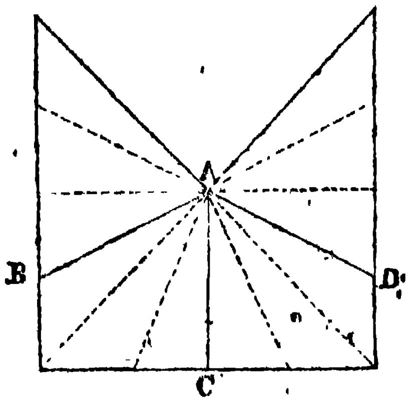


QUERY No. 63. Page 352.

DIVISION OF A SQUARE.

Divide each of the three remaining sides of the square into four equal parts, and draw lines from every third point, counting from one of the upper angles to the centre of the square:— This will divide the figure into four parts. By drawing dotted lines from the remaining points also to the centre, it will be evident that each of the four divisions will contain three triangles, making twelve in the whole, which triangles, according to the 37th prop. of the 1st book of Euclid, are equal to each other, for they stand upon equal bases and between equal parallels; and as each division contains three triangles, it follows that the whole figure is divided into four equal parts by the lines A B, AC and A D.

W. K. M.



QUERY, No. 53. Vol. III. page 319.

CAUSE OF THE REPORT OF FIRE-ARMS

SIR,—In reply to the query of S. E. ASH, (No. 53.) I must inform him that the report of a gun or cannon is caused by the constituents of gunpowder, when ignited, entering into a number of new combinations, and becoming instantly converted into various gases, the sudden expansion of which, striking the air with great violence, produces that detonation or report, the cause of which was the object of his inquiry.

Perhaps it may not be useless to inform him that the sudden formation or destruction of an elastic fluid always causes detonation; *gunpowder* is an instance of the former, and the explosion of a mixture of *oxygen* and *hydrogen* gases may be adduced as an instance of the latter, where a vacuum is produced into which the surrounding air rushes with great impetuosity, and causes the loud report, attendant on that experiment. I need scarcely observe that *water* is always formed by the explosion of those two gases.

Trusting that this will fully satisfy his inquiring mind, and thanking you for the space my letter may occupy in your pages, I remain, Sir,

Yours, &c. &c.

PIERRE, M—.

High Street, St. Mary-le-bone

QUERY No. 44. Vol. II. Page 271.

PLATES FOR A VOLTAIC PILE.

In answer to T. E. B. I beg to state that the plates for constructing a Voltaic Pile, may be procured either at Newman's, Lisle Street, Leicester Square, or at Knight's, Foster Lane, Cheapside. The expence of a small set, twelve of each (copper and zinc), will be but trifling.

H. W. DEWHURST.

QUERY No. 65. Page 352.

MOULDS FOR PLASTER MEDALS.

In reply to the inquiry of E. H. let him lay the medal, slightly anointed with sweet oil, on a flat board; surrounding it at a small distance with a rim of pasteboard, about three times the thickness of the medal;—or he may fasten the rim close round it; but in this case, a similar rim must be used to the mould, when taking casts from it. Having done this, take stone brimstone, and red lead, about equal weights; melt them in a pipkin, and when thoroughly incorporated, pour the mixture on the medal, prepared as above; when cold, remove the medal and the mould will be fit for use, from which any number of casts may be taken. If the medal is silver, plaster must be used for the mould, instead of the above, which would blacken the medal.

Yours respectfully,

W. B. jun.

QUERIES.

No. 67.

WHAT should be the thickness of a cubical *vessel of lead*, the length, breadth and depth of which, on the external superficies, are each 10 feet, so that it may swim in the water with two persons in it, weighing 22 stone, and have two feet perpendicular above the water's surface, the density of the water being, to that of the lead, as 1 to 11.34?

R. SKILBECK.

King Street, Soho.

No. 68.

REQUESTED, the mathematical construction of that curious drawing, called the HORIZONTARIUM.

AN AMATEUR.

No. 69.

SIR,—Permit me through the medium of your interesting work, to ask, whether that delightful instrument, called the musical glasses, is to be purchased in London, and also the best method of tuning common tumblers or drinking-glasses, so that they may answer the same purpose.

AN AMATEUR.

No. 70.

SIR,—I shall take it as a particular favour if any of your Correspondents will, through your esteemed publication, inform me of the most approved method of making tracing-paper.

Yours, &c.

R. T.

No. —.

IF the question is not too simple, I

should feel obliged to any of your numerous Correspondents who would inform me what is the best method of cleaning a brush from paint?

J. S.

GOTTINGEN OBSERVATORY.

His Royal Highness the Duke of Sussex, with that ardent zeal for the promotion of useful science, which forms so prominent a trait in his character, has presented to the University of Gottingen for their new observatory, a transit clock completed on the most improved principle, by W. Hardy, who made a similar one for the Royal Observatory, Greenwich, and for other public institutions at home and abroad.

TO CORRESPONDENTS.

We can assure Mr. **Gloyn** that our only motive for declining the insertion of his first letter was, that it involved some points connected with religious subjects, the discussion of which, he must be aware, is totally inconsistent with the objects of the **Mechanics' Register**. The letter we have since received from him, enables us to give his own account of both the remarks which he charges our reporter with having misrepresented; and this we do with great willingness, leaving the members to form their own opinion on the subject. Mr. **Gloyn** says, first, that his observation was, that "the Mechanics' Register might be considered as the organ of the Institution," not the *authorized* organ; and secondly, that he did not say that "the Society ought to have been consulted, before the advertisement was inserted," but merely "expressed his surprise that the Committee did not, by their Report, inform the Society that *they had* inserted such an advertisement." With respect to the advertisement itself, we candidly confess, that we did not entirely approve of it. Our objections were, however, of a nature very different from those upon which Mr. **Gloyn** appeared to lay so much stress; for we are decidedly of opinion, that the Committee are perfectly justified in letting the Theatre on Sundays, as well as other days, for purposes which are not contrary to the law of the land; but while we are willing to allow Mr. **Gloyn**, and every other individual, the full enjoyment of their own ideas on religious matters, we are still of opinion, that even if the majority, or the whole of the members of the Institution, were disciples of Mr. Taylor, the Society, as a body, would be guilty of an act of madness, were they to suffer the Theatre to be devoted to an attempt at the subversion of that religion which is a part of the established law. We certainly thought, that two subjects were blended together in the advertisement, which should have kept separate; but we are convinced, that the Committee were actuated only by a desire to benefit the Institution by its insertion. We are not sorry that Mr. **Gloyn** brought the subject under the consideration of the meeting; for, as we are informed that the advertisement has not been repeated since, we think this circumstance must convince those members who objected to it, that the Committee are anxious, if possible, to meet the wishes of all their constituents.

Our *sincere* friend, T. M. B. has our *sincere* thanks for his very able animadversions on our manifold imperfections. He has done us injustice, but in spite of our efforts to put ourselves in a passion with him, we could not help admiring the manly and energetic style of his letter, which we read from beginning to end with surprising good humour. We are happy to add, that the rancour and passion with which he charges us, have subsided into a perfect calm, and as we cannot but suspect, that our correspondent's mental thermometer was approximating to *fever-heat*, when he dictated his communication, we hope, by this time, we may congratulate him on having arrived at the same cool temperature as ourselves.

Investigator's letter has been transmitted according to his request.

We cannot resume the discussion which is the subject of **Juvenis Admirator**'s letter.

W. K. M. is requested to accept our thanks for his suggestion, which we shall be happy to carry into effect, as soon as we can make arrangements for that purpose. We shall be obliged to him for the article to which he alludes and are willing to leave its length to his own discretion; merely requesting him to condense it as much as may be consistent with perspicuity.

To **Ein Freund** we reply, that the meaning of the sentence alluded to is, that there are four cutting teeth [illegible] *each jaw.*

W. C. has been partly anticipated, but will be attended to in our next.

Mr. Dewhurst's intentions, we have no doubt, are friendly, but he must allow us to form our own judgment of whatever communications he may transmit to us for insertion. The specimen he has inclosed in his last letter is by no means a favourable one.

Several of our Correspondents will find their favours inserted in the present Number, and others will be attended to as soon as possible.

THE LONDON
MECHANICS' REGISTER.

"To be a niggard of one's observation, is so much worse than to hoard up one's money, as the former may be both imparted and retained at the same time." SHENSTONE.

No. 80.] SATURDAY, APRIL 1, 1826. [Price 3*d*.

DR. WOLLASTON'S CAMERA LUCIDA.

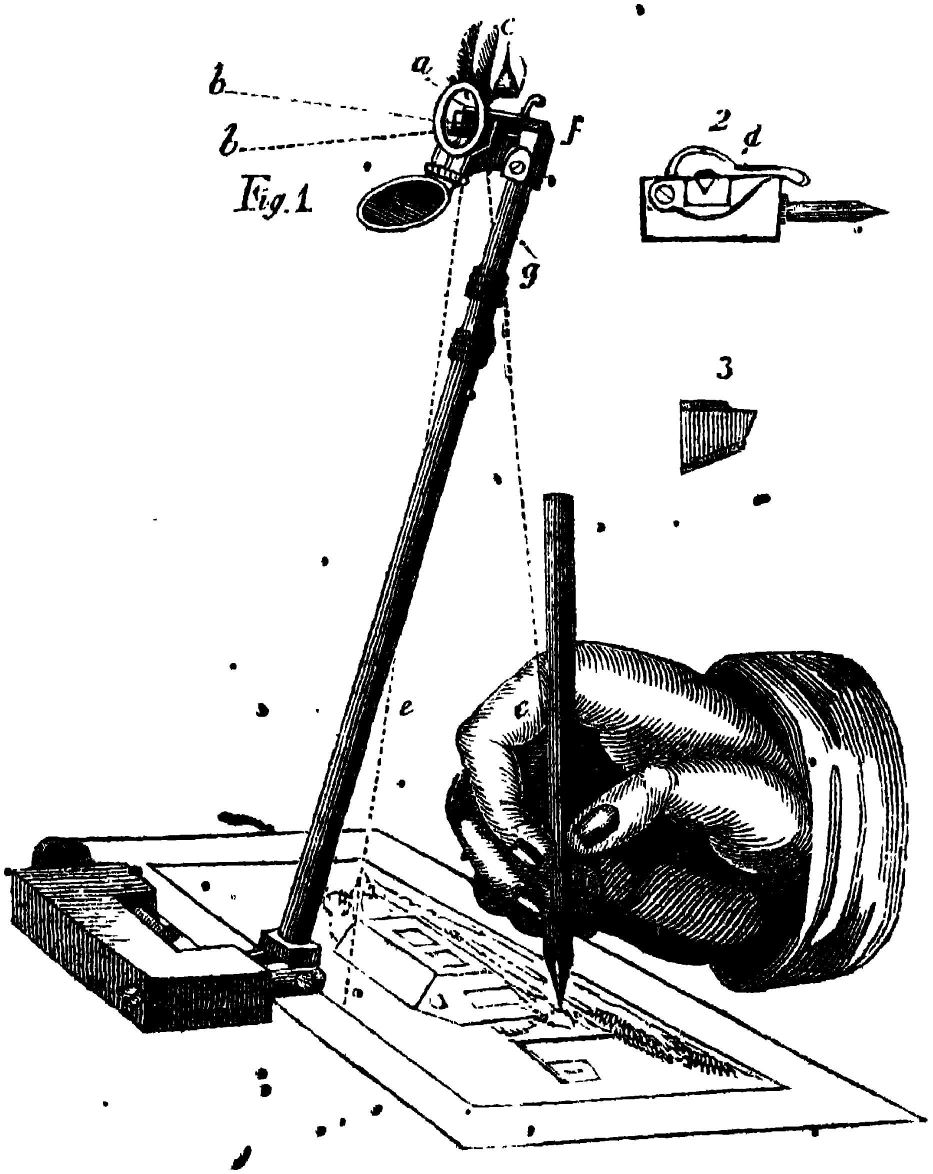
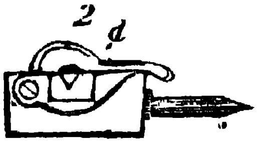


Fig. 1

2



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DR. WOLLASTON'S CAMERA LUCIDA.

This ingenious instrument is applicable to the purposes of drawing objects from nature, and of copying, enlarging, or reducing drawings already made. It is represented in operation in the frontispiece to the present Number (fig. 1), and consists of a glass *prism, a*, mounted upon a stand, but seen detached at fig. 2, and in section at fig. 3; which prism receives the picture of any objects placed before it in the direction of the rays shewn by the dotted lines, *b, b*; the picture being very distinctly seen by looking down perpendicularly into the prism, in the manner represented by the eye situated at *c*.

The intention of the CAMERA LUCIDA is to throw the picture formed in the prism down upon the table or paper below (*k*), for the purpose of tracing its outline with a pencil. This is effected by a particular adjustment of the eye-hole in the sliding-plate,[*] *d*; attention to which circumstance is, above all others, necessary in using this instrument.

The stem which supports the prism is connected, by a double joint, with the clamp at the bottom; so that its inclination may be altered in any direction. The clamp is intended either to screw upon the edge of a table, or to lie down flat as a fulcrum.

The prism is attached to the stem by means of its pin, which slides into a hole at top; and as the squareness of the picture depends upon the truly horizontal position of the axis of the prism, the joint *f*, will allow of this adjustment. The prism must be turned *vertically* upon its pin, and *horizontally* by the sliding of the stem in its tube, until the flat glass face is directly opposite the object to be delineated.

In the horizontal representation of the plate *d* (fig. 2) a small hole will be seen, through which the picture is to be viewed in the prism; and if this slider is so adjusted, by turning upon its pivot, that the edge of the glass prism intercepts about half the hole, then by looking down perpendicularly through the hole, the picture will be seen in the prism, and at the same time, the fingers and pencil of the draughtsman below. By these means the point is enabled to trace accurately the outlines of the picture *apparently* depicted upon the table or paper, as at *k*, fig. 1.

With respect to the magnitude of the intended drawing, it should be observed that, as the dotted lines, *e e*, which descend from the prism to the table or paper, *diverge*, the magnitude or scale of the drawing under the hands of the draughtsman, will depend upon its distance from the prism, which may be regulated at pleasure, by drawing the sliding stem, *g*, more or less out of the tube; observing that the stem must be slightly inclined from the perpendicular, for the purpose of bringing the picture clear of the clamp at bottom. It is recommended that, for all distant objects, the stem should be drawn out of the tube to the mark D engraved upon it; and for objects that are two, three, four, or five feet from the prisms, the stem should be drawn out only as far as the respective marks, two, three, four, and five; but after a little practice, it will be found that such exactness need not be attended to.

If the strength of light falls upon the object to be drawn, and the light which falls upon the tracing-pencil be equal, then the eye-hole may, as above, be cut by the prism exactly in the middle. But if the light upon the object be more intense than that which falls upon the pencil, the sliding plate must be drawn back a very small distance, in order to make the tracing point visible; or, if the light which falls upon the pencil be the strongest, then the sliding plate must be pushed forward a small distance over the prism, in order to make the object more distinct, which a little practice will make familiar. Bright daylight (but out of the sunshine) will always be most favourable to the use of this instrument; it may, however, be used by candlelight, attention being paid to the distribution of light, as above.

If an original drawing be placed at one foot from the face of the prism, and the stem be extended, so that a perpendicular line from the table to the prism be one foot, then the outline traced by the pencil will be a copy upon the same scale as the original. If the original be at two feet distance, and the table only one, then the copy will be half the scale. If the original be at one foot, and the table be at three feet, then the copy will be enlarged to three times the scale.

In this application of the instrument, care must be taken to place the centre of the original drawing directly opposite the face of the prism; and it is also to be observed, that the drawing to be copied should not be very large, or it would, in that case, become distorted towards the extremities.

The instrument may be used with or without the lenses, *h* and *i*, attached to the prism. For an old or long-sighted person, the convex lens, *i*, should be placed under the prism, as at fig. 1. For a short-sighted person, the concave lens *h*, should be turned before the prism; or, for a perfect-sighted person, they may both be dispensed with, and folded back.

LONDON MECHANICS' INSTITUTION.

MR. TATUM'S FIFTH LECTURE ON ELECTRICITY.

PLATE ELECTRICAL MACHINE—NEGATIVE AS WELL AS POSITIVE ELECTRICITY OBTAINED FROM IT—ELECTRICAL ANECDOTE—ATTRACTION OF POSITIVE AND NEGATIVE ELECTRICITY FOR EACH OTHER—SUPERIORITY OF THICK OVER THIN GLASS FOR THE ELECTRICAL BATTERY, &c.—PERFORATION OF TINFOIL AND CARDS, BY THE ELECTRIC FLUID, &c.

MONDAY, MARCH 20TH.

MR. TATUM performed the experiments of the present evening with the *plate-machine*, instead of the cylindrical machine usually employed; and he commenced his lecture by calling the attention of his audience to the construction of this apparatus, in which the electricity is evolved by the friction of silk on a large circular plate of glass, which is substituted for the glass cylinder attached to the common machine. The plate-machine possesses considerable advantages; but it has been supposed, that *negative* electricity cannot be produced by it, as it is usually constructed, because the machine cannot be insulated without placing it upon a stool with glass legs, and using a glass handle. This, however, is an erroneous opinion, for a jar may be charged *negatively*, as well as *positively*, by the plate-machine. To exemplify this fact, MR. TATUM suspended a Leyden jar to the conductor of the machine, and held the knob of a second jar in contact with the exterior coating of the first while the machine was turned; and the effect of the experiment was, that the first jar became *positively*, and the second *negatively* charged.

In the course of his remarks on the phenomena of electricity, the Lecturer introduced an amusing anecdote of an individual who, some years ago, obtained a degree of celebrity by his nocturnal exploits, in disturbing the repose of his neighbours by knocking at their doors, ringing their bells, &c. This person, who was a grocer, was known by the name of *Count Fig*; and a gentleman who had been annoyed by his conduct devised a plan for curing him of his tricks, which met with complete success. The gentleman connected the knocker of his door with the knob of a Leyden jar, by means of a wire, and placed another wire, which communicated with the exterior of the jar, under the door, in such a situation, that any person who attempted to knock at the door must tread upon it. He charged the jar pretty highly, and the result was exactly what he anticipated; for the Count trod upon the wire, and the moment he touched the knocker, he received so severe a shock, that he was thrown backwards upon the pavement in a state of insensibility, where he was found and recognised by some girls of the town, and it is needless to add, that this adventure gave him a lesson which he did not soon forget.

The mutual attraction of *positive* and *negative* electricity, or of bodies in a *redundant* or *deficient* state, was forcibly shewn by an experiment with the electrophorus. On the resinous plate of this instrument the Lecturer traced successively with the knobs of two jars, the letters P and N; the former with a *positive*, and the latter with a *negative* jar. He then propelled upon these letters from an Indian rubber bottle, a powder consisting of a mixture of *red lead* and *sulphur*, when it was immediately seen that the letter P attracted only the sulphur, and the letter N only the red lead, and the two letters, therefore, appeared respectively red and yellow. The same effect was also shewn by propelling the mixt powders upon the knobs of two jars.

the one *positively*, and the other *negatively* charged; for in this case, the former jar selected the *sulphur* and the latter the *red lead*, and their knobs of course exhibited the two different colours as in the former experiment.

It was doubted, at one time, among electricians, whether *thick* or *thin* glass was preferable for the construction of an electrical battery, but the Lecturer thought the superiority of the latter might be easily demonstrated by a very simple experiment. He then produced two pieces of glass of the same size, but of very different thicknesses; the one being of common window glass, and the other of thick plate glass; both were coated with tinfoil, and being successively charged with the electric fluid, it was found that the *thin* plate required about five turns of the machine to charge it, while the *thick* plate was charged by half a turn. From this experiment, it was evident that the *thin* plate was capable of containing a charge nearly ten times as strong as the *thick* one, and, consequently, that *thin* glass was better adapted for the construction of a battery than *thick*. The only disadvantage is, that if the glass be too thin, a spontaneous discharge is apt to break the jar.

Mr. Tatum then performed the experiment of directing the electric fluid through the sides of a phial filled with oil, by means of a steel point which passed through the cork, and was successively directed to different parts of its interior surface. (Vide Vol. I. p. 41.) The phial was completely perforated in several places, one of the fractures being nearly an inch long; the oil oozed through the perforations, and if the operation had been continued, the bottle would have been completely separated into two parts.

A large battery jar was then charged, and the shock was passed repeatedly through a piece of tinfoil, and several pieces of card placed together. These substances were completely perforated, and the Lecturer observed that, upon examining the orifices, it would be seen that they were perforated *downwards*, which distinctly marked the course of the fluid from the interior to the exterior of the jar. The cards were then thrown among the Members in the Pit, who were requested to notice that a sulphurous smell might be distinguished, upon applying them to the olfactory nerves.

After some further observations, Mr. Tatum concluded his lecture, by repeating the final experiment of the preceding Friday evening, in order to afford those Members who were not electrified upon that occasion, an opportunity of participating in the *pleasure* of an electric shock. The communication being formed as before, some hundreds of the spectators successively partook of the treat, and the lecture terminated amidst the laughter and plaudits of the audience.

MR. TATUM'S
SIXTH LECTURE ON ELECTRICITY.

COMPARATIVE EFFECTS OF ELECTRICITY ON CHILDREN AND ADULTS—FURTHER EXPERIMENTS WITH THE LEYDEN JAR —MATERIALITY OF THE ELECTRIC FLUID—ELECTRICAL BATTERY—COMMUNICATION OF MAGNETIC PROPERTIES BY THE ELECTRIC SHOCK, &C.

THURSDAY, MARCH 23D.

ON commencing the present evening's lecture, Mr. Tatum observed that he had received a letter from a gentleman, whom he supposed to be a Member of the Institution, requesting some information on the subject of administering electricity to a child. The Members were aware that he was not a medical professor, and he acknowledged himself incapable of giving a decisive answer to the enquiry that had been made With respect to the comparative effect of an electric shock on a child and an aged person, he thought, however, that there was little difference, except that the constitution of the one was *drier* than that of the other; and, as it is known that fluids are good conductors of electricity, this circumstance might make some difference in the effect produced upon children and elderly persons. But whether the effect of an electric shock was likely to be more beneficial in the one case than in the other, the Lecturer did not pretend to determine; he had not, in the course of his reading, met with any observations on this point, and he considered the question more adapted to the consideration of a medical man than to his own. He thought that any opinion as to the medical effect of electricity ought to be founded on experiment, and as he had no opportunities of making those experiments, which could alone enable him to speak decisively on the subject, he trusted that the gentleman who had written to him would not suppose that he was actuated by motives of disrespect, in not giving a more satisfactory answer to his enquiry. He was happy to find that there were individuals in the Institution who were animated with a spirit of enquiry, and who were disposed to put questions, and also to agitate in their own minds those subjects upon which they wished for further information. Every part of science is calculated to improve the mind, and we may derive advantage even from the study of metaphysical questions. It is true that metaphysics labours under greater disadvantages than physical science, because metaphysical facts are not demonstrable by experiment. The Lecturer had heard several persons disputing upon a metaphysical point, and each claimed the victory; but this is not the case with physical science, in which the various truths it inculcates are susceptible of experimental proof. Mr. Tatum here adduced, *from his own lectures*, several instances of the superiority of *physical* over *metaphysical* science.

The Lecturer then proceeded to some further remarks on the *Leyden jar*, and performed some additional experiments, illustrative of its nature and properties. Having charged a jar to a considerable degree of intensity, which was indicated by the index of the quadrant electrometer, he cut off the communication with the earth by detaching the chain from the machine, and presented the knob of the charged jar to the negative conductor. Now it follows that, as the supply of electricity is derived from the earth, and this supply is now wanting, the negative conductor of the machine will abstract the electricity from the jar, when the cylinder is put in revolution. This was shewn to be the case; for upon turning the machine, the index of the electrometer soon fell down to a perpendicular position.

He had shown, upon a former occasion, that if two jars were charged, the one *positively*, and the other *negatively*, they would discharge each other if their knobs were brought in communication; but what would be the effect, if both were *positively* charged? In this case the contact of the knobs would not discharge them, but they may be made to discharge each other by forming a communication between the outside of one jar and the interior of the other. Mr. Tatum exemplified this effect by charging two jars from the positive conductor of the machine, and then making use of two discharging rods, crossing each other, so as to form a connection, at the same moment, between the interior of the first jar and the exterior of the second, and also between the interior of the second and the exterior of the first. The consequence was that the two jars were simultaneously discharged.

The Lecturer then shewed that electrical attraction is capable of overcoming the *attraction of gravitation*; for a feather, suspended below the conductor, was powerfully *attracted upwards* when the machine was turned; a glass feather was afterwards attached to the upper part of the conductor, and the revolution of the cylinder caused its hair-like filaments to distend themselves till the feather assumed the form of a semi-sphere. Mr. Tatum then passed a small conductor over the extremities of the feather at a short distance, when the numerous filaments followed its motion, and a rattling noise was heard, which accompanied the passage of the electric fluid from the feather to the moving conductor. Persons who stand on an electrical stool while the fluid is communicated to them, sometimes experience a particular sensation in the head, and an effect takes place somewhat analogous to that exhibited by the glass feather in this experiment, owing to the escape of electricity from the hair.

Mr. Tatum next adverted to the doubts which have been entertained, whether electricity be *material*, or only a *property of matter*. Referring to several of the experiments previously exhibited, he expressed himself of opinion that electricity is a material substance, and observed that he could not conceive how it was possible that a mere *property of matter* could perforate pieces of card, of glass, or of metal. In the hydraulic experiments which the Members had witnessed, they had seen a rapid revolution produced by jets of water striking against the atmosphere; and if he could produce a similar effect by means of electricity, he had a right to conclude, by analogy, that the electric fluid acts in the same manner as the water, and is therefore a material substance. A brass fly, or cross, the extremities of which were furnished with points, bent at right angles, was now suspended upon a centre, and electricity being conveyed to it from the machine, the streams of the electric fluid passing from the four points, and striking against the air, caused the fly to revolve in the opposite direction. By reversing the direction of the points, the motion of the fly was reversed; and when the apparatus was so adjusted, that two of the points were directed each way, no motion took place when the electric fluid was communicated; because, in this instance, upon a principle with which every mechanic is acquainted, the *action* and *re-action* were equal.

The materiality of the electric fluid was further shewn, by its causing a smaller fly, with similar points, to travel up an inclined plane, or in a direction contrary to that of gravitation; and in another experiment, a horizontal cross, to the extremities of which four small clappers were suspended, was put in revolution by the same means, and the clappers were made to ring a chime of bells, placed in the form of a circle, by striking them in succession as the fly revolved.

After the performance of some other experiments, which we have before described, particularly the operation of wiping out the interior of a highly charged jar, and the *deflection* of the magnetic needle, an electrical battery was constructed, consisting of five large jars, and the Lecturer proceeded to exemplify the communication of magnetic properties to bars of steel by means of the electric shock. As we have already described these experiments, in our reports of Mr. Tatum's former lectures, and also in the lectures of Mr. Lewthwaite and Mr. Gowring (Vol. II. pp. 115, 116; Vol. III. page 250), it is unnecessary to repeat the description here.

Mr. Tatum concluded, by stating that his next lecture would be devoted to the illustration of *Atmospheric Electricity*, and the nature of thunder and lightning, whirlwinds, waterspouts, &c.

Mr. TOPLIS, who presided during the evening, then repeated the notice previously given to the Members, respecting the commencement of Mr. WALLIS'S Lectures on Wednesday evening next. As the Lecture of each Wednesday would be repeated on the succeeding Friday, the Committee requested that the Members would select whichever evening might best suit their own convenience, and apply to the Secretary for the tickets of admission, which had been prepared for the purpose of dividing their attendance between the two evenings.

Though the Theatre, from the large portion of it occupied by Mr. Wallis's apparatus, would not contain at one time the whole of the Members who were expected to attend, yet, when they were separated into two divisions, a considerably greater number might be conveniently accommodated. The Committee had, therefore, determined to issue about 200 tickets, at 5*s.* each, for the admission of Ladies, or other friends of the Members to the course of Lectures, either on Wednesdays or Fridays. These tickets were ready for delivery, and might be had of the Secretary, at the Office of the Institution.

Mr. TOPLIS added, that he felt great gratification in announcing to the Members, at the request of the Committee, that a gentleman, named JONES, had paid into the hands of the Bankers, at the beginning of the present month, the sum of TWENTY POUNDS, as a donation to the funds of this Institution. This gentleman presented a donation, to the same amount, in the month of March, 1825; but as the Committee were unacquainted with his address, they were unable to thank him as they ought. They conceived, however, that the Members would, like themselves, feel highly gratified by being made acquainted with benefactions of so generous a character.

This agreeable communication was received with loud and unanimous applause.

LECTURES FOR NEXT WEEK.

Wednesday, April 5th, Mr. WALLIS'S First Lecture on Astronomy.

Friday, April 7th, the same Lecture repeated.

SPITALFIELDS MECHANICS' INSTITUTION

The Ballot for the Election of Officers for this Institution took place on Monday evening last, when THOMAS GIBSON, Esq., the President, the four Vice-Presidents, and the Treasurer, were unanimously re-elected, and fifteen new

Committee-men were chosen, in lieu of those going out by rotation.

The Society having now been established twelve months, the Fourth Quarterly General Meeting of the Members was held on Wednesday evening, when the chair was taken by Mr. **Gibson**, who was supported by Thomas James, Esq., Robert Graham, Esq., and Dr. Mitchell, Vice-Presidents, and James Stanger, jun. Esq. Treasurer. The First Annual Report of the Committee, which was of a very gratifying nature, was then read by Mr. Downes, the Secretary.

After a few introductory remarks, the Report proceeded to observe, that the Committee had no hesitation in stating that, considering all circumstances, the Institution had advanced, during the short period of its existence, beyond their most sanguine expectations.

The attempt to establish a Mechanics' Institution in that populous district, although made under such auspicious circumstances, and attended with so much success, was not made without the powerful and serious opposition of some, while others, who were not actually hostile to the measure, did not hesitate to express their misgivings with regard to its tendency, or their forebodings of its speedy termination; but the experience of one year had yielded the Committee the proud satisfaction of a complete triumph over the one, and a proof of the groundless alarm and false predictions of the others.

The total disbursements for the year, amounted to nearly 950*l.*; but of this sum, by far the greater part had been expended in apparatus, furniture, books, and other articles, for which the Society possessed property. The current expences of the Institution, upon the present scale of expenditure, were calculated at something less than 300*l.* per annum.

The Report of the Sub-Committee for Lectures detailed the various courses delivered during the year, and paid a handsome tribute of respect to the Lecturers, particularly to those gentlemen who had gratuitously devoted their talents to the benefit of the Institution. The gratuitous course of ten Lectures on Mechanics, delivered by Mr. **Downes**, the Secretary, was considered as a good earnest of the advantage the Institution is likely to receive from the abilities of that gentleman, as one of their future public Lecturers, and the Committee dwelt with much satisfaction on the Lecture already delivered on oxygen gas, by Mr. **Hemming**, one of the newly-elected Committee, who had also engaged to give two others on the properties of other gases.

The Report of the Apparatus Committee enumerated the various valuable philosophical instruments added to the Museum, and that of the Book Committee stated the number of volumes now in the Library to amount to 474, of which 213 had been presented to the Institution.

The Schools, with the exception of the English Grammar Class, which had been discontinued for want of pupils, were well attended; and the Chemical and General Enquiry Classes continued their meetings as usual. The interest excited by the latter classes had rather increased than subsided, and the progress many of the Members had made in scientific knowledge, afforded the best testimony of their usefulness.

The Report concluded by calling on the Members to make every exertion to increase their numbers, and, by so doing, to effect the grand object of their wishes—the permanent prosperity of the SPITALFIELDS MECHANICS' INSTITUTION.

The Report was cordially received by the Members, and the thanks of the Meeting were afterwards unanimously voted to the Lecturers, the Committee, the President, Vice-Presidents, &c. and also to the Secretary, Mr. **Downes**, for his valuable services, his excellent course of Lectures, his general urbanity and his zeal in forwarding the interests of the Institution.

The proceedings of the evening afforded great satisfaction, and we sincerely hope the concluding recommendation of the Committee will be particularly attended to by the Members.

INTRODUCTION TO THE STUDY OF BOTANY.

(Continued from page 317.)

CLASS 6. HEXANDRIA.

50.—The stamens of this class are six, and differs from the class *Tetradynamia* by the stamens being all the same length, while in the latter two are shorter than the other four. Its orders are four.

51.—1. *Monogynia*, one pistil—Here are the *Galanthus*, snow-drop, too common in our gardens to need a description; the large and beautiful genus of *Narcissus*, or daffodil, sometimes appearing as early as the snow-drop; the yellow species are extremely common; *Allium*, garlic, known by its strong odour, yet some of its species have very pretty flowers, as the *Allium Ursinum*, ramsons, which even renders the milk of cows who feed on it useless, by infecting it with the nauseous and powerful odour of its genus; the gaudy tulip (*Tulipa*) known to every one; *Ornithogalum*, star of Bethlehem, whose flowers are of a brilliant white above and green underneath—the flowers are said to be *corymbose*, because the peduncles (flower-stalks) do not go off at one point as in the umbel, but start from the stem or central peduncle at various heights; the *Scilla*, squil, one species *Scilla nutans*, harebell-squil, or as it is frequently called *blue bottle*, is among the earliest ornaments of our woods—nearly all the species have blue flowers, the others white but never yellow; *Asparagus*, asparagus growing wild on the sea coast, is cultivated in our gardens.

52.—Here is also the splendid tribe of lilies, one of which, "the silver mistress of the vale," (*Convallaria majalis*), I choose as a specimen of this class.

53.—The leaves are two, radical—that is, springing from the root, elliptical—a variety of egg-shaped leaf, but longer, pointed and many ribbed; the petiole (leaf stalk) is longer than the leaves, erect—this term does not imply strictly perpendicular, for the stem may bend on either side and still be erect.—The peduncle (flower-stalk) is also radical, bearing a curved cluster of several pendulous, very elegant white flowers. There is no calyx; the corolla or blossom is bell-shaped, of one petal, but divided into six spreading, reflected (bent outwards) segments: the filaments are awl-shaped—that is, slender, and becoming finer towards the end—terminating in cloven anthers; the germen is roundish with an upright triangular style, supporting a triangular stigma: the berry, which your readers must remember I mentioned as a species of pericarp—the pericarp being formed from the enlarged germen, is globular, and of three cells, each cell containing two seeds.

54.—2. *Digynia*, contains *Oxyria*, mountain sorrel.

55.—3. *Trigynia*. Dock (*Rumex*), some species of which most are acquainted with. Here is the *Colchicum*, meadow-saffron, whose growth is so very curious, I cannot refrain from giving Paley's description of it: "The seed-vessel which in other plants is situated within the cup of the flower, or just beneath it, in this plant lies buried ten or twelve inches under ground within the bulbous root.—As this plant blossoms late in the year, and probably would not have time to ripen its seed before the access of winter, which would destroy them, providence has contrived its structure such, that this important office may be performed at a depth in the earth out of the reach of the usual effects of frost. The maturity of the seed, which in other plants proceeds within a capsule exposed with the rest of the flower to the open air, is here carried on, and during the whole winter, within the heart, as we may say, of the earth. But there a new difficulty presents itself—seeds though perfected, are known not to vegetate at this depth in the earth. A second admirable provision is therefore made to raise them above the surface when they are perfected, and to sow them at a proper distance, viz. the germ grows up in the spring, upon a fruit stalk, accompanied with leaves.—The seeds now, in common with those of other plants, have the benefit of the summer, and are sown upon the surface.—The order of vegetation externally is this:—the plant produces its flowers in September; its leaves and fruits in the spring following."

56.—4. *Polygynia*; pistils numerous; contains the *Alisma*, or water-plantain, of five species, growing in pools and ditches.

CLASS 7. HE[illegible]NDRIA.

57. The number of stamens in this class is seven. It contains only one British plant, *Trientalis*, chickweed-winter-green, growing on turfy heath, and mountainous countries. Its stem is about three or four inches high, crowned with a tuft of very elegant white flowers.

58. Among foreign plants of this class is the *Æsculus hippocastanum*, horse chesnut, a tree of great beauty,

and sometimes growing to an immense size. The great chesnut of Mount Etna measures 160 feet in circumference, and, "although quite hollow within, the verdure of the branches is not affected; for this species of tree, like the willow and some others, depends upon its bark for subsistence.—The cavity of this enormous tree is so extensive, that a house has been built in it, and the inhabitants have an oven therein, where they dry nuts, chesnuts, almonds, &c., of which they make conserves; but as these thoughtless people often get fuel from the tree that shelters them, it is feared that this natural curiosity will be destroyed by those whom it protects." The flower-buds and leaf-buds of this tree are worthy of strict examination—

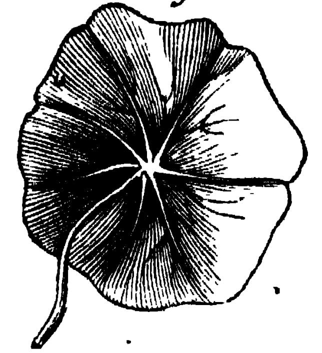
> "Ordered by an intelligence so wise,
> As might confound the Atheist's sophistries."

It produces "the embryos of the leaves and flowers in one year, and brings them to prefection the following.—There is a winter therefore to be gotten over. These tender embryos are in the first place wrapped up with a compactness which no art can imitate: in which state they compose the bud. This is not all—the bud itself is enclosed in scales; which scales are formed from the remains of past leaves, and the rudiments of future ones. Neither is this the whole; the bud has a coat of rosin or gum, which, being congealed, resists the strongest frosts—on the approach of warm weather, this gum is softened, and ceases to be an hindrance to the extension of the leaves and flowers." The flower buds may be distinguished from the leaf buds by their greater size.

CLASS 8. OCTANDRIA.

59. This class, known by its eight stamens, contains many valuable foreign plants; but it is my intention to confine myself to native plants, of which there are several very beautiful. We select the *Œnothera*, evening primrose, as an example—It is common in gardens, and most abundant on the sand-banks of Lancashire and the west coast of England. It flowers from July to September. The stem is about two or three feet in height, rough and somewhat hairy. The leaves are *ovate-lanceolate*—that is, formed like an egg, but tapering to each extremity. The flowers grow from the bosoms of the upper leaves, large and handsome, of a bright yellow, consisting of four flat, heart-shaped petals (Fig. 1. Page 328): the calyx is of one leaf, divided into four oblong segments; the filaments (*b*) are shorter than the petals and incurved, supporting oblong, *peltate* anthers (*a*)—*peltate* implies that the filament is inserted into the centre of the anther, a leaf is likewise said to be peltate, or target shaped, when the petiole is inserted into the centre of the leaf, or nearly so (as Fig. 5).

Fig 5



60. *Epilobium*, willow-herb, is a large genus of nine species, growing in most places, easily known by the very long germen, and the four spreading, handsome, purple petals.

61. *Vaccinium*, whortle-berry, a small ever-green shrub, with elegant reddish flowers. The berries are of a black or red colour, and very grateful to the taste.

62. *Daphne*, mezereon, distinguished by the flower having no corolla; and the calyx being coloured and similar to a corolla. It has only two British species, the Daphne *mezereum*, common mezereon with a crimson coloured calyx; and the Daphne *laureola*, spurge laurel, with a green calyx and four of the yellow anthers just appearing in the throat of the calyx.

63. *Acer*, maple and sycamore—the former tree grows small in its uncultured state, but when large is very valuable, and was celebrated among the ancients for tables; indeed, so valuable was this wood, that a table, made of it, cost Cicero more than 80*l*., and some are reported to have sold for their

weight in gold. The latter is a large tree of quick growth, and useful for many purposes. The *sugar maple*, another species, "yields in a good season from twenty to thirty gallons of sap, from which are made from five to six pounds of sugar. This sap flows for about six weeks in the early spring. During the remaining summer months, a thin liquor is yielded, not fit for distillation, but supplying a very pleasant drink."

64. Here are also the heath (*Erica*), known to every one; the *Chlora*, yellow-wort, whose leaves are said to be *perfoliate*, because the stem runs through them; hence its name Chlora *perfoliate*, perfoliate yellow-wort.

65.—3. *Trigynia* has but one genus.

66.—4. *Tetragynia*, contains *Paris*, herb paris, of one species, Paris *quadrifolia*, common herb paris, so called because the stem bears only four leaves at the top, where they form a whorl with a central green flower.

67. *Adoxa*, moschatell, is a small herb with *twice ternate* leaves and pale green flowers. A *ternate* leaf is when a petiole has three leaflets (Fig. 6, *a*); a *twice* ternate leaf consists of three such ternate leaves, placed on a common petiole (Fig. 6, *b*); and a *thrice* ternate leaf is three twice ternate leaves, placed also on a common petiole (Fig. 6, *c*).

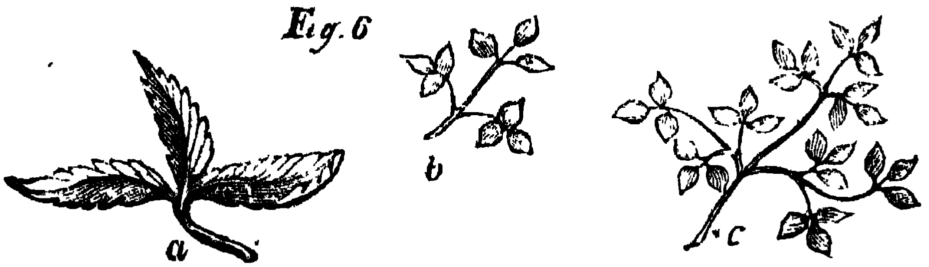


Fig. 6

68. *Elatine*, water-wort, as its name implies, is an aquatic plant, and very uncommon. The flowers are white or reddish, generally of three petals, sometimes four, and smaller than the calyx.

69. The flowers of this class are very irregular in the number of the different parts of fructification.

Rye. TYRO.

[*To be continued.*]

The following errors occur in the 78th Number. Par. 36. for Briffonia, read Buffonia. Par. 37. Mœnœchia, mœnchia, read Moenchia, moenchia.

P. S. I was much pleased on reading the letter of Francis, jun. (page 362.), on the utility of Botany, and I hope he will perform his promise; by so doing he will greatly assist me in my endeavours to conduct your readers into the garden of Flora, in whose flowery paths they will be taught the power and wisdom of that God who has clothed the earth in such a variety of forms and colours.

DR. BLACK'S EXPERIMENT ON CALORIC.

To the Editor of the Mechanics' Register.

SIR,—The objection of a JUVENILE PHILOSOPHER (more explicitly stated in his reply to my answer) against the conclusion drawn by DR. BLACK, from his experiment on the latent heat of water, appears plausible, but it is not, I believe, unanswerable.

On attentively considering the circumstances of ice at 32°, and water at 40°, it certainly seemed very reasonable to suppose that, in equal times, the ice would abstract from the surrounding medium, a greater portion of heat than the water; and in this supposition I was confirmed by the following deduction by Dr. Black:—"The celerity with which caloric or heat is communicated from hotter bodies to colder ones, is nearly proportional to the difference of their temperature."

But when, on the other hand, I considered that Ure, Murray, Nicholson, Thomson, Brande, and other eminent chemists,) have explained the experiment in question, on the assumption of the influx of heat being equal, I felt disposed to believe, notwithstanding the plausibility of the objection, and its apparent confirmation by the above stated deduction of Dr. Black, that it could not be valid. However, as the results of experimental investigation are, in researches of this nature, more satisfactory than theoretical deductions, or the fallible authority of great names, I will endeavour to recall to the minds of your readers some experiments which will, I think, elucidate this subject.

1. In my last letter, I stated that equal weights of ice at 32°, and water at 172°, produce, on mixture, a temperature of 32° only; hence, as a quantity of heat sufficient to raise the thermometer 140° disappears, it has been concluded that this quantity of heat combines with the ice and renders it fluid; and, on this account, it has been called the '*Caloric of Fluidity;*' or, from its ceasing to affect the thermometer, '*Latent Heat.*'

2. Mix equal weights of ice at 32°, and water at 212°, the resulting temperature will be 52°; thus the water loses $(212 - 52) = 160^\circ$ and the ice gains only 20° that are appreciable by the thermometer; hence $(160 - 20) = 140^\circ$ have become latent.

3. If water be cooled to 22°, and then, by agitation or otherwise, be made to freeze, a fourteenth part of the whole will be frozen, and the temperature will rise to 32°; here the water that freezes gives out its latent heat, viz. 140°, which being equally divided among the fourteen parts, raises the temperature of each 10°; that is, 22° to 32°.

4. If ice and water of the same temperature be placed equi-distant from a fire, the ice will be melted into water at 32°, in precisely the same time that the water requires to attain the temperature of 172°; and $172 - 32 = 140$ as before.

5. The above-quoted experiments are, I think, sufficient to prove that 140° is the quantity of heat that ice absorbs during its conversion into water. Taking this for granted, which so many concurring experiments justify us in doing, the truth of the proposition is, in my opinion, demonstrable; for, in the experiment referred to, the temperature of the water rose from 33° to 40° in half an hour, and it required twenty half-hours to convert the whole of the ice into water of the temperature of 32°; but, by the before-mentioned experiments, it is proved that 140° is the quantity of heat necessary to the liquefaction of ice; and by this experiment, the time consumed in the liquefaction is twenty half-hours; hence, $\frac{140}{20} = 7^\circ$ = the quantity of heat absorbed in each half-hour, and this is the precise quantity that the water acquired in one half-hour; consequently, the influx of heat into the two bodies is equal and uniform.

6. To corroborate the above, if further corroboration be necessary, I will state one more experiment. A lump of ice at 22°, was suspended in a room at 50°: in five minutes its temperature rose to 32°, but it took fourteen times 5 or 70 minutes to become dissolved. In this experiment, we see that, in the first portion of time, *when the ice was at 22° only*, the temperature was increased 10° in five minutes; and afterwards, *when the ice was at 32°*, it absorbed heat in the same ratio; viz. 10° in every five minutes; calculating the latent heat of water at 140°.

With respect to the difference of sensation perceived on touching ice and water, both at 32°, it *may* arise wholly from what, in my first communication, I assigned as a partial cause.

My authority for having assigned conduction as producing part of the effect, is Dr. Henry, who, in his Chemistry, says "It is chiefly owing to the different conducting powers of bodies that they affect us when we touch them, with different sensations of heat."

With cordial thanks to your Correspondent, for involving me in so interesting and profitable a discussion, and an apology to you for the unavoidable length of this letter,

I remain, Sir,
Yours respectfully,
S. P.

CEMENT FOR BROKEN GLASS, &c.

To the Editor of the Mechanics' Register.

SIR,—One of your correspondents, in No. 77, (page 335) speaking of cement, reminds me of one which I made when a boy, in imitation of "Vancouver's Cement, or Iron Glue;" which I believe had just then come out, and which found a very ready sale.

My imitation was tried by many persons, all of whom declared it was quite equal to that which it was intended to imitate.

The quantities of the ingredients I have entirely forgotten; but the articles were *sulphate of zinc,* and the best *ceruse* or *dry white lead,* finely powdered, and accurately mixed together.

It should be kept in a bottle well corked, and when wanted, a little of it should be mixed with rain water, and applied in the usual way to the china, glass, or other damaged article.

As cements are so continually in request, I have sent you an account of this, hoping it may prove serviceable to some of your readers;

And am, Sir,
Your very obedient servant.
F. C.

LONDON GYMNASTIC SOCIETY.

A public Meeting was held on Wednesday, the 22nd ult., at the Theatre of the LONDON MECHANICS' INSTITUTION, for the purpose of taking into consideration the propriety of establishing a Society for the encouragement of GYMNASTIC EXERCISES, according to the system which has been introduced into this country by Professor VOELKER, and taught by him for some time past with considerable success. The object of the proposed Institution appeared to have excited considerable interest, for the Theatre was completely crowded in every part.

Dr. GILCHRIST took the Chair, in compliance with an application made to him by a number of Gentlemen, who have interested themselves in the formation of this Society, and several Resolutions were proposed by Messrs. REYNOLDS, JONES, and other gentlemen, who introduced them by appropriate speeches, in which they expatiated on the advantages of Gymnastic Exercises, regulated on a system which was calculated to bring the whole of the muscles of the human frame into active operation. The Resolutions were all unanimously adopted, and at the close of the proceedings, about 200 persons entered their names in books opened for that purpose, as members of the Institution. It is intended to procure a piece of ground, in a central situation, as a gymnasium, and the subscribers to the plan are to pay 2s. 6d. per month to defray the necessary expenses, and entitle themselves to a participation in its advantages.

As we intend, in a short time, to lay before our readers some account of the principles of Professor VOELKER'S system, and the nature of the exercises of his pupils, we shall conclude our brief notice of the above Meeting with the following observations, extracted from a pamphlet circulated by the Provisional Committee, which will be sufficient to convey a general idea of the grounds upon which the introduction of gymnastics is supported by the projectors of the Institution:

> "IT may be truly said, that the revival of GYMNASTICS, so long buried under the ruins of antiquity, is one of the greatest advancements yet made in the science of education, and not among the least conspicuous improvements of the present enlightened age. Every one who reflects,—every one who knows any thing, knows, and by experience, how intimate a connexion there exists between body and mind,—how invariably the healthy or sickly temperament of the one influences that of the other; that when the body is strong, healthy, and active, so is the mind cheerful and elastic; and that when the former is sickly and diseased, so is the latter languid and depressed. The ancient Greeks and Romans understood this, and their education was accordingly directed to the developement, not only of the mental, but also of the corporeal powers; and this corporeal branch of education was termed Gymnastics.
>
> In the middle ages, however, when education got into the hands, and was at the sole disposal of the monks, it is not surprising that Gymnastics altogether disappeared. The lords of the soil indeed, knights and princes, contended at their splendid tilts and tournaments, but the mass of the people were degraded and enslaved, the more

effectually to administer to the pleasures and the pride of their oppressors. This age of chivalry, as it was termed, passed away however in succeeding ages; even these knightly games became extinct, and Gymnastics gradually losing ground, were at length reduced to the very name, known possibly to some musty philosophers, who might have stumbled on it in their insane, because indiscriminate, enthusiasm for whatever might bear the stamp of barbarism or antiquity. In modern times, however, more practical men have sprung up amongst us—men who not only have detected, but pointed out, and as far as in them lay, supplied the deficiency. To these men—Professors Gutsmuths and Jahn—the merit of the discovery, and revival of this long lost art,—"this relic of an age gone by"—is more particularly due. After a careful examination of the structure of the human body, they devised numerous exercises, arranged them in a well adapted series, and again restored Gymnastics to something like their former rank and importance.

In many towns of Germany and Switzerland Gymnasiums were established. The youth, and even grown men, soon derived more pleasure from exercises which fortified, than in pleasures which paralized the powers of their bodies. By the consciousness of increased vigour, the mind too became powerfully excited, and strove for equal perfection, and the constant ambition of every pupil was to verify in his own instance, the truth of the adage, "*Mens sana in corpore sano,—A sound mind in a healthy body.*" Even the naturally indolent were irresistibly carried away by the zeal of their comrades; persons, diseased and weakly, recovered their health, for the restoration of which these exercises were possibly the only effectual remedy. The certificates of physicians, wherever Gymnastics were introduced, concurred as to their healthful tendency, nor were the highest testimonials from parents and teachers found wanting. Indeed, all young men who cultivated them, were acknowledged to have improved in health and morals, and to have acquired an open, free, and graceful deportment.

That an institution similar to the one proposed, is, and has long been, a desideratum in this huge metropolis, will be obvious to all who reflect on the impossibility of persons whose employments are sedentary, attaining, after the confinement and anxiety of the day, a requisite portion of healthful exercise and excitement to recruit and "exhilarate the spirit, and restore the tone of languid nature." This desirable object, it will be admitted, is not accomplished by the dull, monotonous, and even pernicious practice of listlessly strolling about the streets without a definite or a useful motive; still less, by dissipating the remnant of their already abused faculties in the unhallowed atmosphere of the tavern or the club. To the clerk, this course will but accelerate the mischief arising from eight or ten hours' "dry drudgery at the desk's dead wood;" to the artisan, it is not calculated to ensure peaceful slumbers, and to enable him to meet the duties of the morrow "with nerves new-braced and spirits cheered."

In hypochondriacal, and all other melancholy disorders, people are too apt to acquire the notion, that mind alone is concerned; whereas, the body will usually be found to own at least an equal share, if not indeed the origin, of the evil. There is a mutual re-action between them, and by lessening it on one side, you diminish the pain on both. Hypochondria is the name of one of the regions of the stomach—a very instructive etymology. The blood of a melancholy man is thick and slow; that of a lively man clear and quick. A natural conclusion, therefore, is, that the remedy would be found in putting the blood into action. "By ceaseless action all that is, subsists." Exercise is the best means of effecting it, as the impulse given by artificial stimula is too sudden, the effect too transitory, and the cost to nature too great. Plato had so high an opinion of the medicinal powers of exercise for disorders of the mind, that he said it was even a cure for a wounded conscience.

PRISMATIC COLOURS.

To the Editor of the Mechanics' Register.

SIR,—I have frequently witnessed the phenomenon mentioned by your very excellent correspondent G. H. (page 269) and I have thought, on investigating the subject, that the surfaces of such reflectors have innumerable minute projections, and that when the light passes those fine edges, a refraction and refrangibility of the rays takes place, so that the prismatic colours are the result. It is well known that when the rays pass the edge of a knife, the prismatic colours are produced. They are also produced by reflection in a most beautiful manner on soap-bubbles, and this is probably effected by minute atoms of alkaline matter projecting above the surface of the bubbles, and presenting innumerable fine edges which separate the rays into the prismatic colours.

I remain, Sir, yours, &c.

D. THOMAS.

ANSWER TO QUERY.

QUERY, No. 63. Page 352.

DIVISION OF THREE-FOURTHS OF A SQUARE.

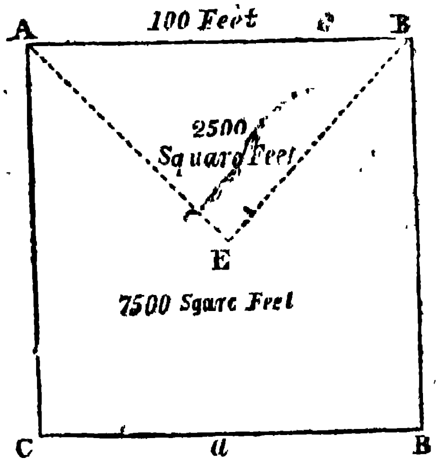
MR. EDITOR,—I shall feel much obliged by the insertion of the following diagrams in your valuable Register. They will be found perfectly correct, whether constructed by the help of mathematical instruments, or calculated by an arithmetical process. The Query No. 63 is very simple, and I have endeavoured to preserve the same simplicity in the definition of the several answers, which I trust will be satisfactory to your correspondent, L. S., and prompt him to propose some other Query relative to the division of land, which may be instructive to that portion of your numerous readers, who may feel interested in subjects connected with that delightful study, Practical Geometry.

I consider any more diagrams than I have transmitted, for allotments to be made upon the ground or area of such a figure as proposed by L. S. would be unnecessary; however, should you, Mr. Editor, approve of what I now send to you, or any other subject I may transmit in future, rest assured it will afford me particular pleasure to contribute an occasional paragraph to your excellent miscellany.

Mr. Editor, yours very truly,

W. C.

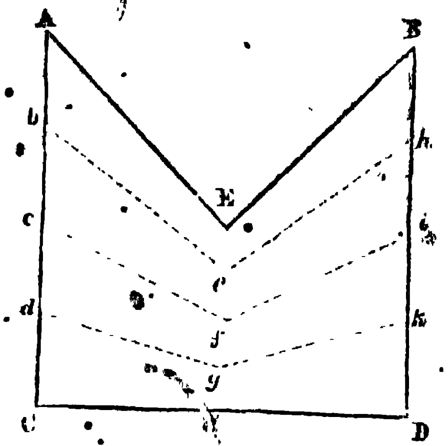
For the sake of calculation and construction, I will suppose the square to contain 10,000 superficial square feet (each side being 100 feet), from which one-fourth, or 2500 square feet, being deducted, leaves 7500 which, divided by 4, gives 1875 square feet for each of the divisions. To understand all problems of this kind, I recommend in the first place the construction of them; in this case as the figure named is a square, I construct it mathematically to begin,



and then mark the angles with A, B, C, and D, Then, in order to take out one-fourth of the area according to the manner represented by L. S., the opposite angles A, D and C, B, being joined in pencil, the point E is obtained, after which draw the lines E, A and E, B, in ink, which will leave the area (to be equally divided into four parts) clear for inspection and consideration. It will thereby be evident that a line produced from E to *a* will divide the remainder into two equal parts, therefore all the trouble necessary will be to subdivide one of them equally into two parts, and transfer by the dividers the point or points of division to the other side, and the figure will be divided as was requested by L. S."

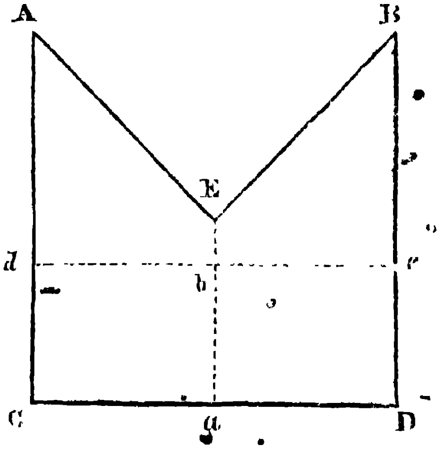
Diagram 2.—It will be evident to many of your readers that this Query wants no calculation whatever, but simply the correct division of A C, E *a*, and B D, into four equal parts, as at *b c d*, *e f g* and *h i k*. Then according to Euclid, as triangles, &c., upon the same bases and between the same parallels are equal to each other, produce the dotted lines *b e h*, *c f i* and *d g k*, and the four divisions will be exactly equal in area to each other.

Fig. 2.



For Diagram 3.—The area included between A, C, *a*, E and A being 3750 superficial square feet, divide 3750 by 2, and the quotient 1875 by 50 feet (the side C *a*), the quotient will be 37½ feet, the side *a b* or C *d*, which being set off also from D to *e*, there will remain only to draw the line *d b e*, to divide the figure into four equal parts.

Fig. 3.



For Diagram 4.—Draw the dotted line E *a*, then set off the half of it, namely, 25 feet, from A towards C, and from B towards D, and mark them with *b* and *c*, then draw the lines *b a* and *c a*, those two lines will also divide the figure into four equal parts.

For Diagram 5.—Draw a pencil line *x y* parallel to C D, then from E to *a*, mark a dotted line in ink. Bisect *x* E E *y*, C *a* and *a* D, draw dotted lines in ink from *b* to *c* and from *d* to *e*, draw other dotted lines from *c* to A and from *e* to B, which lines *b c* A and *d e* B will also equally divide the figure into four parts.

Fig. 4.

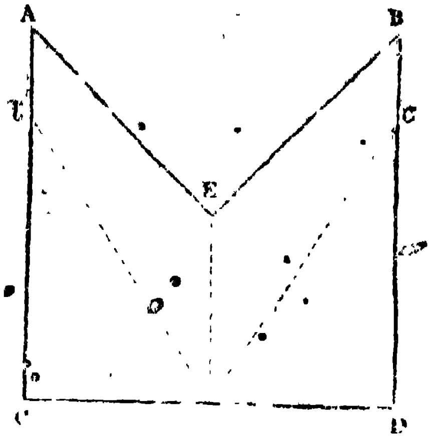


Fig. 5.

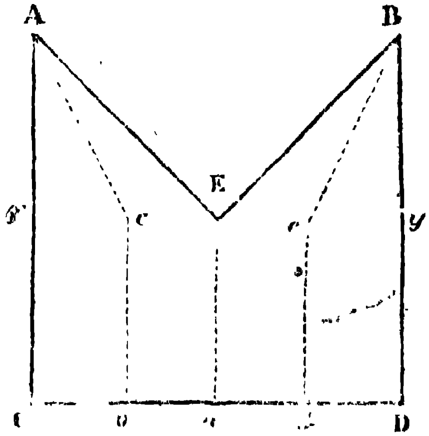
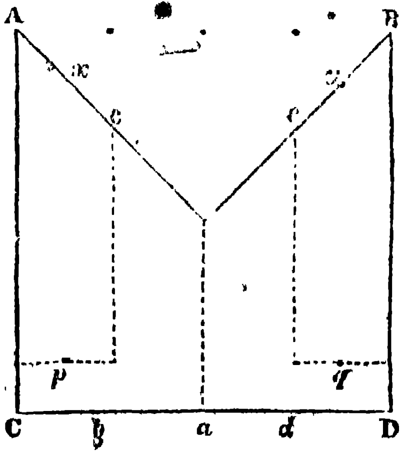


Fig. 6.



For Diagram 6.—Consider you have a base C D, equal to 100 feet, and that, as it is required to divide the area into four equal parts, 25 feet set off on the base and also on its parallel A B, will give you four areas, two equally long and two equally short; when the lines *b c*, E *a* and *d e* are drawn in pencil, you also will see that *b c* and *d e* will be the exact length, viz. 75 feet, which being multiplied by 25 feet will give 1875 feet, therefore you must bisect A *c* and *e* B and lay off *c b* or *e d* from *x* and *y* to *p* and *q*. Then draw a line parallel to C D through the point *p* to the line *c b*, and the same on the other side through *q*, then dot these lines, and from *c* and *e* dot lines downwards to meet them, then dot the line from E to *a*, and the figure will be divided into four equal parts.

The following Diagrams, No. 7, 8, 9 and 10, are also divided into four equal parts, but the process being nearly similar to those already described need not be repeated.

Fig. 7.

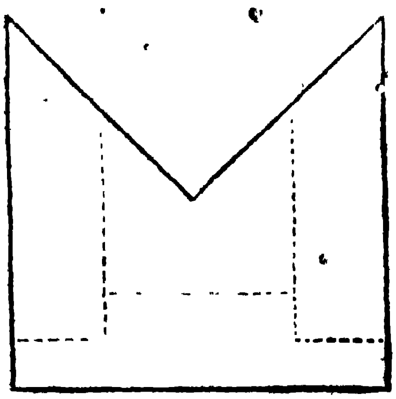


Fig. 8.

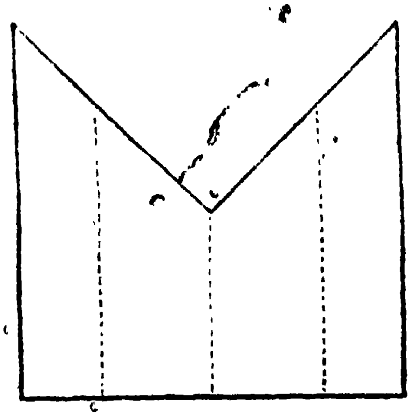


Fig. 9.

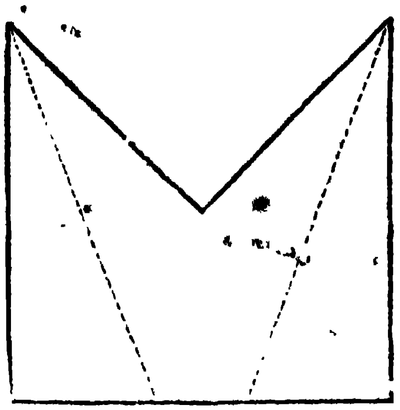
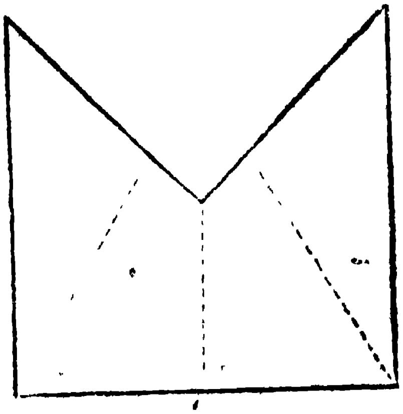


Fig. 10.



TO CORRESPONDENTS.

Mr. *Glovn* requests us to state, that he is not one of Mr. Taylor's disciples, and that so far from this being the case, he never, to his knowledge, either saw or heard him, or any one person with whom he associates.

We shall be happy to receive Tyro's remarks on the other subject to which he has alluded, after he has completed his interesting illustrations of botany.

Francis, jun. will oblige us by transmitting his second letter.

Constantine, J. T., S. M., W. Downing, and T. Taylor, will excuse the non-insertion of their answers to the query relating to the division of a square, as the subject is sufficiently illustrated in the last and present numbers.

The attempt of T. H——h to make the four divisions of the same form is ingenious, but he must see that he has divided the area into eight parts instead of four.

The communication mentioned by D. Thomas has not reached us.

W. W. has requested us to point out an error in the drawing of Fig. 1. in the frontispiece to the last number. The float-wheel, as represented in this figure, appears to pass *under* the board F. instead of *above* it. This error did not escape our notice, but there was not time to correct it, and we hope the third figure rendered the plan perfectly intelligible to our readers.

Answers to other Correspondents next week.

Errata in part of last week's impression.—Page 358, col. 1, line 11, for "14" read "24."—Page 359, col. 2, line 8, for "14" read "84."

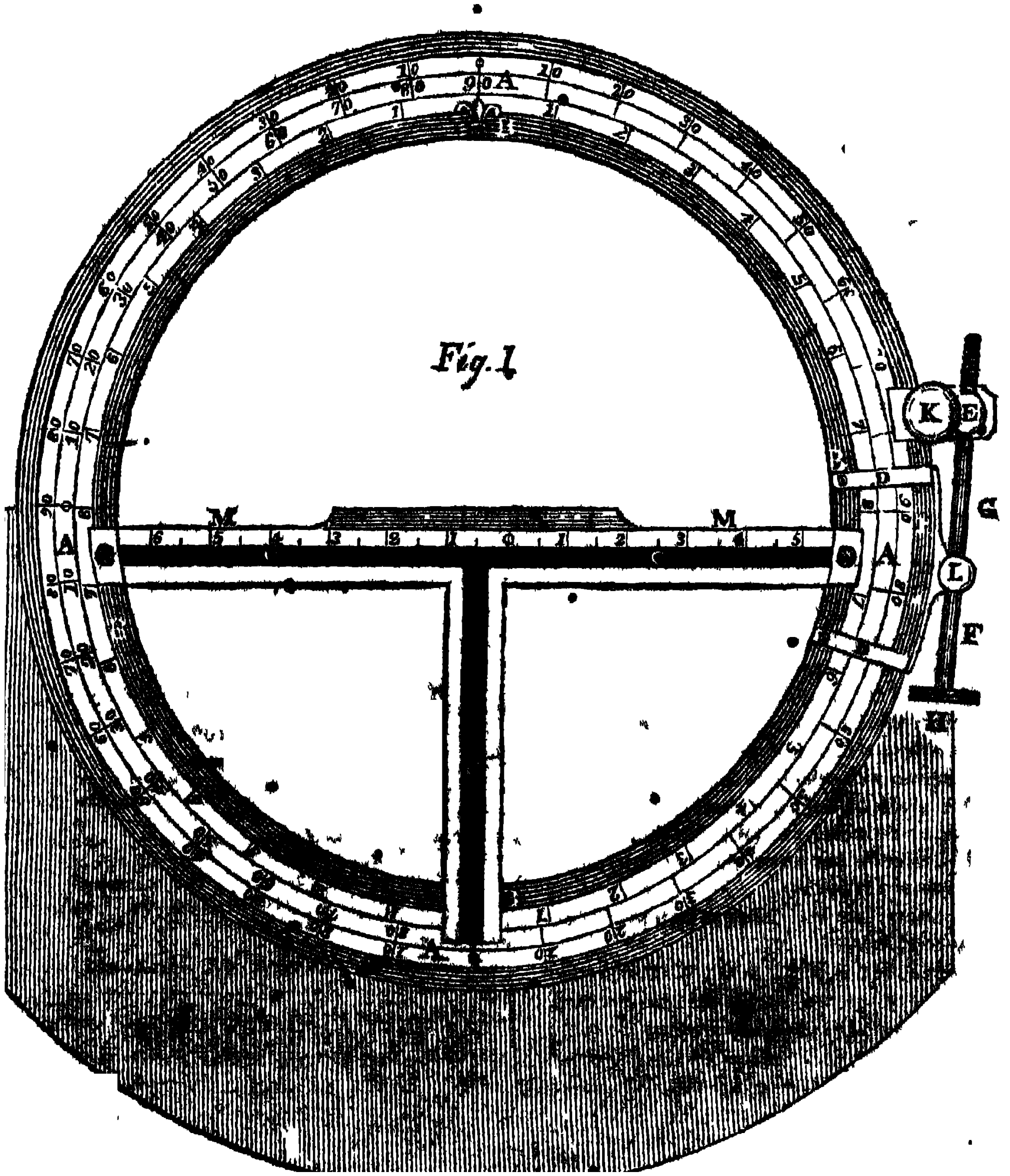
THE LONDON

MECHANICS' REGISTER.

> "He who, through Nature's various walk, surveys
> The good and fair her faultless line pourtrays;
> Whose mind, profaned by no unhallowed guest,
> Culls from the crowd the purest and the best;
> May range, at will, bright Fancy's golden clime,
> Or, musing, mount where Science sits sublime,
> Or wake the spirit of departed time."
>
> ROGERS.

No. 81.] SATURDAY, APRIL 8, 1826. [Price 3d.

MR. HART'S INSTRUMENT FOR THE DELINEATION OF GEOMETRICAL FIGURES.



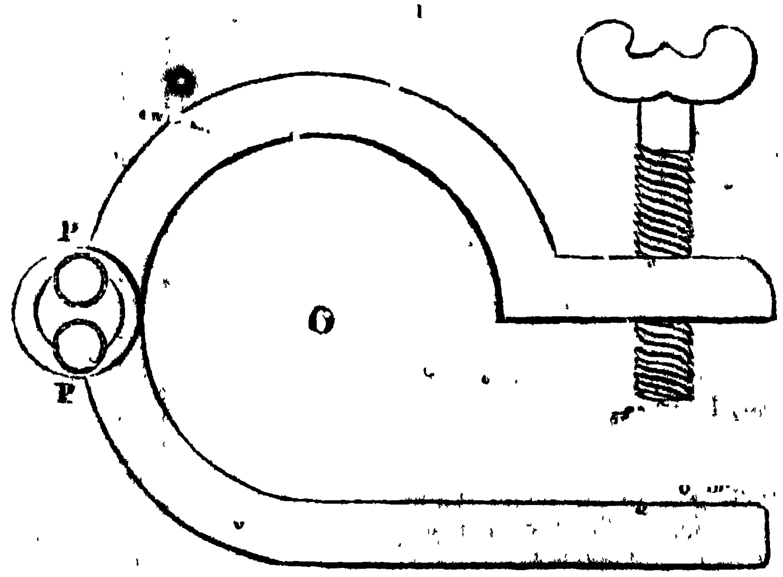
MR. HART'S INSTRUMENT FOR THE DELINEATION OF GEOMETRICAL FIGURES.

It will be in the recollection of our readers that, in our report of Dr. Birkbeck's valuable lecture on various mechanical inventions (page 83 of the present Volume), we gave a brief description of the instrument invented by Mr. Hart of Islington, for the purpose of laying down angles, and of delineating a great variety of rectilinear and curvilinear figures with the greatest accuracy and precision. We then stated our intention to lay before the public a more minute account of this valuable instrument, with the necessary engravings for illustrating its construction, and we are this week enabled to redeem our pledge.

Mr. Hart's instrument is capable of delineating, with great facility and with perfect correctness, geometrical figures of any given dimensions within its range. The engraving which forms the frontispiece to the present Number, and the rest of the illustrative diagrams, are copied from the instrument presented by the inventor to the London Mechanics' Institution, and are represented on a scale of exactly half an inch to an inch; but the apparatus may be constructed of any required dimensions, according to the purposes to which it may be applied.

Angles may be laid down by this instrument to any assigned quantity in degrees and minutes; circles or arcs of circles may be drawn and graduated into any number of equal parts; straight lines may be drawn in any position, and of any given length, to the 200th part of an inch; and elliptical figures may also be described by it of any required proportions. Hence its application (as stated in our former account) to the purposes of architecture, dialling, the projection of the sphere, perspective, fortification, and the construction of scales of chords, sines, tangents, and secants.

The principal parts of the instrument are two concentric circles; the interior circle, B B B B, fig. 1, (vide frontispiece), is moveable within the other, which, when in use, is to be firmly fixed to the table or drawing-board by means of the piece H, and the clamp represented in the following figure.



This clamp has a circular opening, O, occasionally holding a portion of the drawing-paper: it is opened to receive the roll of paper, by removing the steady-pins, P P.

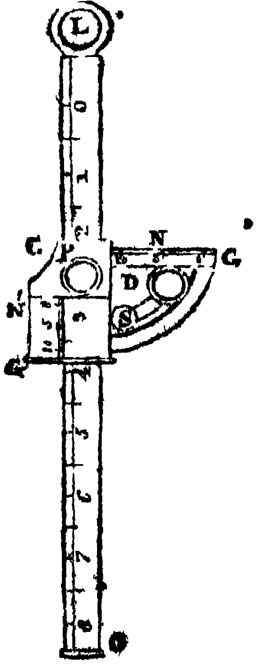
The exterior circle, A A, is divided into degrees and half-degrees, which are sub-divided into minutes by the nonius, N N, attached to the interior circle by the pieces, D D. The nonius is furnished with a tangent-screw, H, for accurately adjusting it to any given position. The tangent-screw turns freely in the collar L, through which

also

it is prevented from passing lengthwise, and screwd into the piece E, which, when used, is clamped to the exterior circle by the screw K, and on being turned, it gradually moves the interior circle either forwards or backwards.

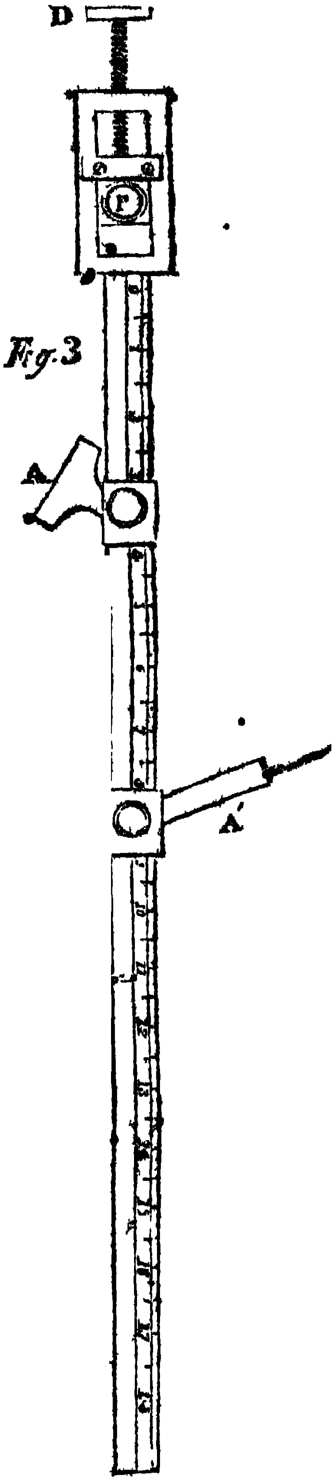
To the interior circle is fixed the diameter bar, M M, which is graduated to the 20th of an inch; and numbered from the centre, both ways to the circumference; and the radius bar, C′, meeting the diameter bar at right angles.

Fig. 2



The slide, G G G′ (fig. 2), fits into the groove C C, in the diameter bar, along which it moves, carrying the vertical bar, L O, which is divided in the same manner as the diameter bar, and by the nonius N′ it is sub-divided to the 200th part of an inch; while the nonius N sub-divides the diameter bar to the same minuteness. S is a capstan screw, for fixing the position of the bar, L O, to the slider, when placed at right angles to the bar M M; and L is a brass tube for holding the pencil or tracing-point, which is loaded with a weight at the top to keep the point on the paper while the figures are drawn.

Fig. 3



The elliptic bar (represented by fig. 3), is also divided to the 20th of an inch; it is furnished with the pencil holder P; the adjusting screw D, and the two coursers *A A*, which fit into and move in the grooves C C & C′. (Fig. 1. Vide frontispiece.)

This apparatus is very convenient, as well as extensive in its application, as every line can be drawn by it at once, of the required length and in any given position: it is also capable of indicating its own errors, and hence the certainty of its operations.

Among the various instances of the superiority of this instrument over the scale and compasses, it may be mentioned, that each operation is performed in a manner totally *independent* of any other; while, according to the usual method, the accuracy of each operation is entirely *dependent* on that of the preceding; and, from the impossibility of assigning to a point its geometrical place, or drawing a line geometrically correct, the errors are regularly transferred, and increase with each succeeding step.

In a future Number, we shall give one or two specimens of the application of Mr. Hart's instrument to the purposes for which it is intended.

LONDON MECHANICS' INSTITUTION.

MR. TATUM'S SEVENTH LECTURE ON ELECTRICITY.

EFFECTS OF THE ELECTRIC SHOCK—ATMOSPHERICAL ELECTRICITY—THUNDER NOT CAUSED BY THE EXPLOSION OF OXYGEN AND HYDROGEN—REAL CAUSE OF THUNDER—EFFECTS OF THUNDER-STORMS—OXIDATION OF GOLD BY THE ELECTRIC BATTERY—TORTUOUS COURSE OF THE ELECTRIC FLUID—AURORA BOREALIS—EARTHQUAKES—WHIRLWINDS—WATER-SPOUTS—EFFECTS OF ELECTRICITY ON VEGETABLE AND ANIMAL LIFE, &c.

WEDNESDAY, MARCH 29TH.

BEFORE entering upon the immediate subject of the present evening's lecture, Mr. TATUM made a few additional observations on the comparative effects of the electric shock on different individuals, in consequence of a second letter which he had received from the Member whose communication he had noticed at the commencement of his previous discourse. He stated, that when a number of persons form a connection and receive the electric shock at the same instant, it is probable, that if they were all asked to describe the sensation they had experienced, each would give a different description from the rest. Some persons are much more susceptible of the effect of electricity than others; as an instance of which it may be stated, that a lady who, upon one occasion, joined hands with a number of gentlemen, scarcely felt any sensation when the shock was communicated, though some of the gentlemen were so much affected, that they could hardly keep their legs. The effect of the shock, therefore, appears to depend upon the constitution, which enables some individuals to bear a much more powerful shock than others.

The Lecturer then proceeded to that important branch of the science, called *Atmospherical Electricity*, and observed, that different opinions had been entertained respecting the cause of *thunder*. He stated, that it was a very general opinion that thunder is caused by the combustion of the mixed gases, *oxygen* and *hydrogen*; but however plausible and popular this idea might be, he was not inclined to adopt it. To establish this hypothesis, it is necessary, in the first place, to prove, that there is a sufficient quantity of *hydrogen* in the air to form an explosive mixture. Now, in the chemical analysis of *atmospheric air*, has there ever been found enough of *hydrogen* to produce such an effect? The Lecturer had repeatedly analyzed atmospheric air, and had scarcely found a trace of this gas. But granting, for the sake of argument, that there is a sufficient quantity of *hydrogen* generated at the earth's surface to form an explosive mixture when elevated into the atmosphere, still, the very small *specific gravity* of this gas must be taken into consideration, and when it is recollected, that the part of the atmosphere where the thunder occurs is not very elevated, it will naturally be inquired, what power is there to retain the *hydrogen* in so low a stratum? It is, in fact, impossible and contrary to nature that this should take place; for the hydrogen, by its extreme levity, must necessarily ascend to a much greater height than the region of thunder. Many of the Members, perhaps, witnessed the ascent of Mr. Green and his brother, which took place yesterday, and though his balloon was filled with *carburetted hydrogen*, which is of much greater specific gravity than *hydrogen*, and also carried up the weight of two men and all its appendages, it passed through the clouds in a few minutes. How, then, is it possible, that *hydrogen* should be retained in a stratum through which Mr. Green's balloon passed so rapidly?

As a proof that thunder is generated in a region of the atmosphere not very elevated, Mr. Tatum instanced the case of an aëronaut, who ascended in a storm. Thunder and lightning afterwards came on, and his friends considered his destruction inevitable; but when he descended, he was scarcely conscious that it had thundered at all. He had heard a distant rumbling noise, like the report of cannon, but he was far above it; and this circumstance proves, that the stratum in which thunder occurs is considerably below that to which a balloon ascends. The Lecturer also read, from Lieutenant Green's Treatise on Lightning Conductors, an account of an extraordinary phenomenon, which occurred in the island of Java, in the year 1772. "On the 11th of August, at midnight, a bright cloud was observed covering a mountain in the district called Cheribeau, and several reports like those of a gun were heard at the same time. The people who dwelt in the upper parts of the mountain, not being able to fly fast enough, a great part of the cloud, about eight or nine miles in circumference, detached itself *under them*, and was seen at a distance rising and falling like the waves of the sea, emitting globes of fire, so luminous, that the night became clear as day." These circumstances are sufficient to prove, that thunder is not caused by any collection of *hydrogen* in the region where it takes place, because *hydrogen* would necessarily ascend much higher.

But, if thunder be not caused by the explosion of *oxygen* and *hydrogen*, from what cause does it proceed? In answer to this question, it may be observed, that the discharge of an electric battery, even of moderate power, is accompanied by a report sufficient to create alarm, in some degree, in the minds of the audience; and if such a report proceeds from so small a surface, what must be the effect of the fluid discharged from a surface of eight or nine miles, as in the phenomenon just alluded to? In the next lecture it will be seen, that steel wire may be melted by the discharge of a battery, for which experiment, Electricians generally select the finest wire they can obtain. But what is the size of such a wire compared with that of one of the conductors placed for the protection of St. Paul's Cathedral, which conductor, notwithstanding its thickness, has actually been made red hot by lightning? Mr. Tatum here exhibited a model of part of the conductor alluded to, which was about 4 inches wide by half an inch thick. How much greater, then, must have been the report which accompanied the discharge of a quantity of the electric fluid capable of producing such an effect, than the sound generated by an electric battery. The effect of echo, which, in some instances, is known to repeat a sound 40 times, must also be considered, and these circumstances are quite sufficient to account for the sound of *thunder*.

Mr. Tatum here repeated his remarks on the effects of *evaporation*, in carrying up into the atmosphere a large quantity of electricity from the earth (vide page 359), and read a second extract from Lieutenant Green's book, to illustrate his opinion, that the conversion of aqueous vapour into rain or hail, diminishes its capacity for electricity, which is then given out in large quantities, and affords a reason for the occurrence of these meteors during a thunder-storm. "On Wednesday evening, July 14th," says Mr. Green, "several heavy storms of thunder and lightning visited London. About one o'clock in the afternoon, Enfield, Waltham Cross, Cheshunt, and their vicinity, felt the severest effects of the storm. It was accompanied with thunder, lightning, and torrents of *hail*. The devastation occasioned by the latter was very great, some of the stones being of the dimensions of pigeons' eggs. The storm was most violent in the middle part of the county of Kent; it entered from Sussex, and passing over the entire weald of Kent, Canterbury, and the towns on the sea-coast, discharged an immense quantity of water, stopping the passage of many bridges and public ways, and laying the low lands under water, spoiling and carrying away vast quantities of hay and seed-grass. The extreme breadth of the clouds appeared to be about 20 miles. The river *Stour* rose rapidly in a few minutes, and the ditches were insufficient to carry off the water. Margate suffered severely, and, at Ramsgate, the flood rose to such a height, near the market-place, as to lay the cellars under water."

The electrical battery was then charged, and the shock being passed through leaves of gold, the oxide of the metal was struck upon some pieces of card, in the form of portraits and other devices. This curious experiment is described at page 50 of our Second volume.

Mr. Tatum next exhibited the *tortuous* or *zig-zag* form of a strong spark, taken from the conductor of the electrical machine, and adduced this circumstance as an additional proof of the materiality of the electric fluid; which, striking against the air with inconceivable velocity, condenses it, and increases its resistance; the fluid, therefore, turns aside to seek out an easier course, and by condensing successive portions of the air, is diverted from a rectilinear direction, and proceeds in a tortuous or zig-zag course. That the resistance of the atmosphere is the cause of this, was demonstrated by exhausting a glass vessel, and passing the fluid through the vacuum, in which case, the direction of the spark was perfectly straight.

The *Aurora Borealis* is an electrical phenomenon, supposed to be produced in very elevated regions of the atmosphere, where the air, which diminishes in density in proportion to its height above the earth's surface, is in an extremely rarefied state. This phenomenon, which is not accompanied by any report, may be imitated, by passing the electric fluid through an exhausted vessel; and it has been doubted whether any report would be heard, if it were possible to discharge a battery in a *vacuum*. The Lecturer here exemplified his remarks, by means of a long cylindrical glass vessel; exhausted of air; and the fluid, as it flashed through the vacuum, exhibited a vivid and beautiful representation of the phenomenon alluded to.

Earthquakes have been imagined, by some persons, to be caused by the discharge of the electric fluid from one portion of the earth to another. The manner in which it is supposed that the effect may be produced, was exemplified by an experiment which our readers will find described in our Second volume, page 84.

Whirlwinds and *Water-spouts* are electrical phenomena, which have some analogy for each other; the former being on land what the latter are on the sea. Mr. Tatum here related the circumstance, as detailed in our First volume, page 76, of his having witnessed the occurrence of a whirlwind in the City Road, some years ago, when a garden-frame, weighing half a hundred weight, was carried to a considerable height in the air, and an unfinished house was set on fire at the same time. He also exhibited an apparatus, resembling a canopy, which supported a circular metallic plate, representing a cloud charged with electricity. On the lower part of the apparatus, which was supposed to represent the surface of the earth, a number of light substances were strewed; and upon turning the machine, with which the apparatus was placed in communication, these light bodies were instantly put in rapid motion, by the powerful attraction of the metallic plate.

A variety of interesting experiments were then performed, for the purpose of exemplifying the effects of the electric fluid in producing *combustion*, and the danger of imperfect lightning conductors. Some combustible materials being placed in the model of a house, were set on fire by passing the spark through a conductor in which there was a break at the part where the combustibles were placed. Gunpowder was ignited in the same manner, in the model of a powder-magazine, and these experiments were intended to shew the manner in which houses or magazines may be fired by lightning, whenever the continuity of the conductors, placed for their protection, is interrupted; for a spark and explosion will always occur at the point where they may be broken.

A cannon, loaded with gunpowder, and an electrical pistol, charged with *oxygen* and *hydrogen*, mixed in the proportions in which they unite to form water, were then discharged by the electric spark, and the fluid was afterwards conveyed to two large bladders, suspended near the upper gallery, and filled with the mixed gases, which exploded at the same moment with a tremendous report.

The Lecturer finally exemplified the destructive effect of the electric shock on vegetable and animal life, by passing the shock of the battery through a geranium, and afterwards through some small fishes contained in a vessel of water. The fishes, on receiving the shock, darted across the vessel, for a second or two, with incredible velocity, and were immediately taken out dead. Mr. Tatum observed, that the effect of the shock on the plant would not become very perceptible before the next lecture, when he should exhibit, among other experiments, the deflagration of several of the metals by electricity.

MR. TATUM'S EIGHTH AND CONCLUDING LECTURE ON ELECTRICITY.

COMBUSTION OF VARIOUS BODIES BY ELECTRICITY — LUMINOUS EXPERIMENTS—EFFECTS OF THE ELECTRIC SHOCK ON VEGETABLES—DEFLAGRATION OF SILVER, PLATINUM, GOLD, STEEL, &C. — CONCLUDING OBSERVATIONS.

FRIDAY, MARCH 31ST.

MR. TATUM'S concluding lecture was diversified by a great number of beautiful experiments, illustrative of the combustion of various substances by the electric fluid, and its luminous effects when the Theatre was darkened. The experiments were performed with an excellent electrical machine, recently mounted by the Committee of Managers, which appeared to act more powerfully than either of those previously exhibited.

Several combustible substances, both solid and fluid, such as *resin*, *lycopodium*, *spirits of wine*, and *ether*, were ignited with great facility; the latter, after the electric fluid had passed through four glasses of *water*; thus demonstrating that the passage of electricity through water, does not deprive it of its igniting properties. The Theatre was then darkened, and the shock of a large jar was passed through lump-sugar, oranges, and eggs; the whole of which assumed a beautifully luminous appearance, at the moment when the fluid passed through them.

The electric fluid always puts on a luminous appearance when it passes from a *good conductor*, such as the metallic conductor of the machine, into the air, which is a *bad conductor* of electricity. Upon this principle, the glass tube now exhibited is constructed, which contains an interior tube, dotted spirally with pieces of tinfoil. The machine was then turned, and the tube instantly assumed a very beautiful appearance, occasioned by the rapid passage of the electric fluid, which became visible in every space between the spots of tinfoil; this, however, is an old fashioned way of producing a luminous effect, and it has been found a much better mode to make the slips of tinfoil, which are placed on the glass, continuous; and then to draw a knife through those parts which are intended to appear luminous. This method is much easier, and the number of sparks may be considerably increased by it.

An elegant apparatus, consisting of a series of revolving columns, was then exhibited; and also a number of devices, displaying in succession the words "SCIENCE", and "ELECTRIC LIGHT;" a beautiful view of the Pagoda Bridge, and an inscription, containing the words, "SUCCESS TO THE MECHANICS' INSTITUTION." The whole of these devices were of the most brilliant description, and were witnessed with loud applause.

While the battery was being constructed for the final experiments, Mr. Tatum exhibited the geranium, through which he had passed the electric shock at the close of the preceding lecture. The effect of the fluid in destroying vegetable life was sufficiently manifest in the appearance of some parts of the plant, though the whole of the leaves were not yet withered. Geranium leaves look well for some time after they are separated from the stem, but the Lecturer had no doubt the plant was as effectually killed, as though it had been divided from the root with a knife.

The battery was now powerfully charged, by the aid of two electrical machines, which were put in action at the same time to facilitate the operation, and the Lecturer proceeded to exemplify the deflagration of metals, by passing the shock successively through wires of *silver*, *platinum*, *gold*, and *steel*. The whole of those wires were instantly fused, and their oxides were seen flying about, with the exception of the *platinum* wire, which resisted the operation, probably, from its being rather too thick for the strength of the battery. The deflagration of the *steel* wire was particularly brilliant.

Mr. Tatum then observed that he had arrived at the conclusion of the course of Twelve Lectures, which he had undertaken to deliver to the Members of the Institution, and he felt that some apology was due to them for having occasionally detained them beyond the usual hour, but he had been anxious to instil into their minds the proper theory and principles of the science, and to illustrate them by as great a variety of experiments as possible. It might perhaps be said, that a Lecturer could stop when he saw that the dial indicated the expiration of the usual time, but he might then be in the middle of a subject which required proper experiments to elucidate it. The Lecturer therefore trusted that these considerations would plead his apology for having sometimes trespassed on their time.

The worthy Lecturer's concluding remarks were received with every testimony of satisfaction by the Members, and he retired amidst the unanimous applauses of [illegible] assembly.

LECTURES FOR NEXT WEEK.

Wednesday, April 12, Mr. Wallis's Second Lecture on Astronomy.

Friday, April 14, the same Lecture repeated.

OBSERVATIONS ON A MAXIM IN MECHANICS.

To the Editor of the Mechanics' Register.

50, Broad Street,
March 29, 1826.

Dear Sir,—Although the letter, transmitted through you to me at the request of the writer, contains, as you must have observed, several erroneous apprehensions, yet, as the writer is evidently a person of education and inquiry, his mistakes, since they may occur in other minds similarly circumstanced, are I think, worthy of public notice. The correction of these mistakes is particularly suited to a work, which, like the "Mechanics' Register," by the kind of discussions it promotes, and the discoveries it records, is calculated to promulgate the truths of science amongst a certain portion of the community, who, otherwise well-informed, are yet very deficient in physical knowledge. If you should concur with me in opinion, respecting the propriety of inserting the letter of "Investigator," you will, perhaps, allow me to occupy a few columns of your valuable journal, by remarks upon its most important positions.

I remain, dear Sir,
Very faithfully your's,
George Birkbeck.

INVESTIGATOR'S LETTER.

To the Editor of the Mechanics' Register.

Brighton, March 15, 1826.

Sir,—It is generally stated, that "*what we gain in power, we lose in time*;" as if it were as certain as that five and five make ten. The Greek word *Mechane*, or wisdom, seems to signify ingenious contrivance. Archimedes applied what are called the Mechanical Powers, but we are not to be chained to his car, or to be debarred from further improvement. Surely, a wheel-carriage may be called a mechanical contrivance—by means of a carriage, a horse may move, on an iron level railway, two or three tons weight, or upwards, while he could neither carry nor drag on the ground one ton weight. Here, then, *we gain both power and time.* This seems a triumph of modern science.

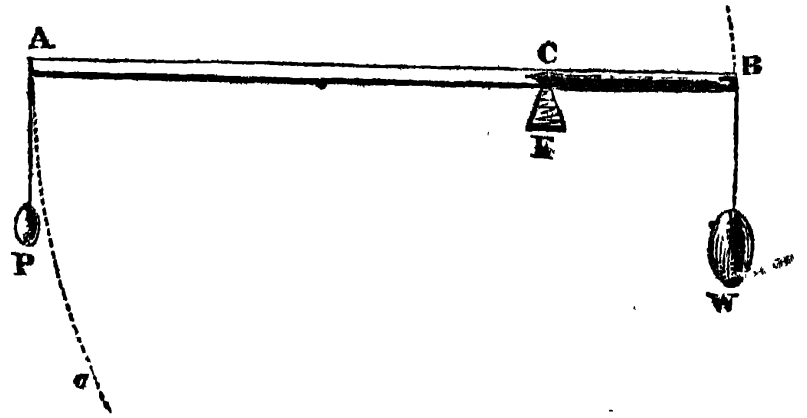
In one of the old mechanical powers, the *pulley*, it is usually said, the power gained is as the number of the pullies. This does not seem correct; but it rather seems to depend on the diameter. If we try one set of moveable pullies of three feet diameter against another set, of twelve pullies, each of three-inch diameter, the large three-feet pullies will raise a greater weight, and in less time, than the set of twelve three-inch pullies. The pullies themselves should, of course, be weighed against each other, as well as the weights attached to them, to enable us to estimate the total weight raised by each. If, then, one man, or several men, be enabled, by a set of large moveable pullies, to raise a greater weight, and in less time, than he or they could by the exertion of natural strength, we gain both power and time. Wheel-carriages, in their mechanism, seem to resemble, somewhat, the moveable pulley. If, in pullies, there were projecting teeth on the circumference, and, instead of a smooth rope, if an iron chain were to fasten on the toothed circumference, it might take a firmer hold. If, too, the axle were toothed, and the teeth of the axle were to work in the teeth or pinions of three circumferences, say, each wheel of ten or eleven inches diameter (supposing large three-feet pullies), this might seem a great improvement on the anti-friction pullies, which have less circumference, and, being smooth, the working is less firm than when toothed. Each of these three ten-inch wheels must, of course, have its own axle.

This system might likewise be a great improvement on carriage-wheels, as the friction would be thrown from the revolving main axle into three circumferences. These things may easily be proved on a small scale.

I remain, Sir,
Your obedient humble servant,
INVESTIGATOR.

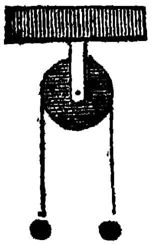
DR. BIRKBECK'S REMARKS ON THE PRECEDING LETTER.

If the often quoted maxim or induction, against which "Investigator" contends, had been thus expressed—what we gain in the magnitude of the effect, we lose or sacrifice in the extent of space passed over by the power—instead of placing time in opposition to power, the same idea [illegible] have been imparted, and misapprehension might have been avoided. The change would indeed have been merely in terms; for the space described being always as the time (the velocity being constant), either element or quantity, may be employed in the enunciation. Of the simple mechanical powers, to which the application of this maxim is more easy than to complicated arrangements, let us take as an example a lever of the first kind.

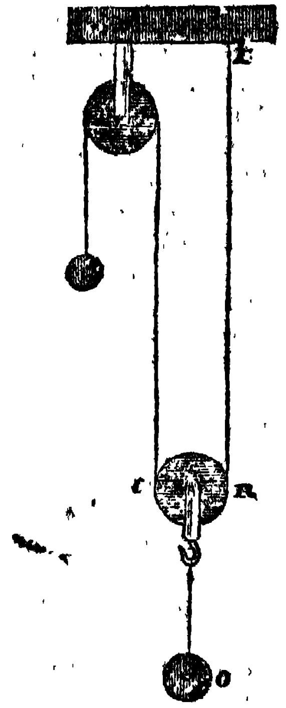


When the power P, balances the weight W, which greatly exceeds it, the arm A C, at which it acts, exceeds C B in the same degree. And if, in consequence of a small addition to P, motion should take place around the fulcrum, F, as a centre, the arc A *a*, passed over by the point A, will exceed the arc B, described in the same time, as much as A C exceeds C B. But in order that the times may be equal, the velocities of the two points must necessarily be very different; and the velocities being the same, which to render the lever an advantageous instrument, ought to be supposed to be the case, the times must be different; longer, obviously, on the side of the fulcrum at which the power is situated, than on the other, in proportion to the greater extent of the arc or circle described. Therefore, what is gained in the apparent magnitude of the effect, is lost in the time or space required for its accomplishment.

With regard to the pulley, termed by Investigator, "one of the old mechanical powers," it may be observed, that when fixed, as in the following diagram, it has no claim to the appellation: it then serves the purpose merely, of altering the direction of the motion impressed by the power.



This is the case whether large or small, although if large, it will answer the purpose better, when a thick or inflexible rope is made to pass over the sheave, on account of diminished flexion. When the pulley is loose, as represented in the figure below, it answers to the [illegible]mon idea of a mechanical "pow[illegible]d when several are thus employ[illegible] "the power gained is as the number of pullies;" or, to speak more correctly, as the number of fixed threads or cords.



It is, indeed, by means of the fixed thread I R alone, that the apparent gain is effected; the weight *o* being divided betwixt the two portions,—that is to say, betwixt I R, and the part proceeding from *c* to pass over the fixed pulley, and be connected with the smaller weight; whatever species of effort is required to counter-balance it, need only be equal to half the weight *o*; and if there be a second loose pulley, of which the cord has one end attached to the beam, and the other to the hook of the first pulley, it is obvious, each of the fixed points bearing half, that a power of one-fourth only will be required. The pulley, it need scarcely be observed, here acts as a perpetual lever, with equal arms; simply affording a rolling cylinder for the flexion of the cord, and not in the slightest degree altering the relation of the power and weight to each other. Hence, we must at once perceive the error into which Investigator has fallen, when he says "the power seems to depend on the diameter;" and the fallacy of his assertion, "that if you try one set of moveable pullies, of three feet diameter, against another set of twelve pullies, of three-inch diameter, the large three feet pullies will raise a greater weight, and in less time, than the set of twelve three-inch pullies."

A wheel-carriage is, it must be admitted, "a mechanical contrivance," well adapted to remove the load from the back of a horse, and to diminish friction, which would be very great if the load were to be placed upon an ordinary road. A rail-road takes advantage of the carriage and the wheel, and affords a still smoother surface for the wheel to revolve upon, thereby still further diminishing the friction or resistance commonly opposed to the draught or power of the horse. It is, in fact, a judicious imitation of the sledge of the Laplander or Esquimaux, or of the long-practised amusement of skating. In none of these instances do we recognise the operation of a mechanical power; yet, by means of a pair of skaits, two plain pieces of steel sliding on ice, a man could convey a load with such celerity and such ease, as would, under ordinary circumstances, be impracticable. None of these, I apprehend, however, constitute a legitimate "triumph of *modern* science," especially, not a triumph over the maxim or induction so long and so often repeated by writers on the science of Mechanics.

Investigator will find, that pullies with spikes or projecting teeth, have often been employed for working with chains, as he proposes, by means of which, a firmer hold is unquestionably obtained. But the toothed-axle, working as he suggests, into the circumference of three toothed wheels, instead of being plane, and resting upon two polished circumferences, as practised in Attwood's beautiful apparatus for the purpose of diminishing friction, would not be found advantageous. The friction of the teeth against each other, would become a materially retarding cause, and would certainly be worse than the mere attrition of the axis against its common bed or support. What could be gained by the *third* wheel, except the labour of causing it to revolve, for it must be placed above the axis and could afford no support, I am unable even to conjecture. In an arrangement of friction-wheels, it appears to me, that it must afford the same advantage, as in wheel-carriages is commonly expected to arise from the *fifth* wheel of a coach.

UTILITY OF BOTANICAL STUDIES.

[Continued from Page 363.]

To the Editor of the Mechanics' Register.

SIR,—According to my promise, I send you my second letter on BOTANY, the subjects of which are to assist the student in his early attempts for the attainment of this science; and secondly, how he may make them conducive to his future amusement and that of his friends, viz. the best and easiest method of collecting and preserving plants.

Most of the terms in this science are of Greek or Latin origin; a previous knowledge of one of these languages will, therefore, render the acquisition of them extremely easy; but if the student be but an English scholar, he may, in a great measure, omit them until actual practice brings them into use, when the frequency of their occurrence will insensibly impress them and their signification upon the memory.

The first thing to be studied is, how to distinguish one plant from another; this is done chiefly by considering the formation and arrangement of the several parts of the flower.

To do this, let the student take Dr. Thornton's Grammar of Botany, (the most explanatory book upon the subject), and Galpine's Synopsis of British Botany, which books, together with a herbal, form a small, but very comprehensive botanic library: and let him read over, two or three times, that part of the first of these books which treats of the different parts of the flower.

Then let him provide himself a few plants, with the names of which he is acquainted, as a *wall-flower*, *primrose*, *violet*, &c. and dissect them, comparing every part, as it is separated from the rest, with the description given in the Grammar before him. This operation, three or four times repeated, will give him an adequate [illegible] of the different parts of [illegible] general. But here let me [illegible] to lose his time on [illegible]. No flower is naturally [illegible] has only become so by excess of nourishment or cultivation. They are totally neglected by botanists, not only because they are unnatural, but because they are deficient in the most important parts, viz. the *stamens*, while the *petals* are redundant, consequently they present no criterion whereby to distinguish the different species of them from each other and from other plants.

After the student has thus dissected a few plants which he was previously acquainted with, let him collect some which are unknown, and dissect these also; this dissection, however, must be done according to system. First, separate the *stamens*, the number and position of which will directly indicate to what *class* the flower belongs. Then consider the *pointal* or *pointals*, the number of which places the flower in the proper *order* of that class. The next division to which it is to be brought, is the genus; this is found by considering the number and shape of the *petals*, *seed-vessel*, and *calyx*, and sometimes the *nectary*. The genus being ascertained, it only remains to find the *species*; to do this he must consider the colour of the plant, situation where it grew, time of flowering, and shape and position of the leaves; in which he will be greatly assisted by reference to the proper part of Galpine's Synopsis.

Having thus discovered the name of the flower under his consideration, nothing remains but to refer to it in his herbal, to find the virtues and curious properties belonging to it.

It will be observed by the botanist, that the above observations can only apply to the first thirteen classes. The remainder of them, as well as the orders belonging to them, are, for the most part, dependant upon circumstances totally different from those above mentioned; but as I have taken up already so much of your paper, and my own time, I must defer the developement of them, as well as the method of forming an *herbarium*, till next week, when I hope to finish the subject.

[illegible] FRANCIS, jun.
55, Great [illegible] St. Whitechapel.

STRUCTURE OF THE HUMAN BODY. —MECHANISM OF THE FORE-ARM —MAMMÆ OF MALES.

To the Editor of the Mechanics' Register.

MR. EDITOR,—No piece of machinery is more curiously devised according to the nicest contrivances of art, or more interesting or deserving the study of the mechanician (though it is apt to be overlooked by him) than the structure of man himself; of which the most beautiful definition is afforded in the Scripture, which says, "that he is fearfully and wonderfully made." A French writer, in allusion to this, says, "Durst we make a single movement, or stir a step from the place we were in, if we saw our blood circulating, the tendons pulling, the lungs blowing, the humours filtrating, and all the incomprehensible assemblage of fibres, tubes, pumps, valves, currents, pivots, which sustain an existence at once so frail and presumptuous?" To give the reader an idea of the perfection of some of these contrivances (from which useful hints may be taken), I will quote what the philosopher Paley says, in his 'Natural Theology,' of the fore-arm only.

"Another mechanical contrivance is seen in what anatomists call the fore-arm; that is, the arm below the elbow and wrist. Here, for the perfect use of the limb, two motions are wanted; a motion at the elbow backward and forward, which is called a reciprocal motion, by which the palm of the hand, as occasion requires, may be turned upward.

"How is this managed? The fore-arm, it is well known, consists of two bones, lying along side each other, but touching only towards the ends. One, and one only, of these bones is joined by the cubit, or upper part of the arm at the elbow; the other alone to the hand at the wrist. The first, by means at the elbow of a hinge-joint (which allows only of motion in the same plane), swings backward and forward, carrying along with it the other bone and the whole fore-arm. In the mean time, as often as there is occasion to turn the palm upward, that other bone to which the hand is attached, rolls upon the first by the help of a groove* or hollow near each end of one bone, to which is fitted a corresponding prominence in the other. If both bones had been joined to the cubit or upper-arm at the elbow, or both to the hand at the wrist, the thing could not have been done. The first was to be at liberty at one end; and the second at the other; by which means the two actions may be performed together. The great bone which carries the fore-arm, may be swinging upon the hinge at the elbow at the very time that the lesser bone, which carries the hand, may be turning round it in the groove. The management also of the grooves, or rather of the tubercles and grooves, is very observable. The two bones are called the *radius* and the *ulna*. Above, that is, towards the elbow, a tubercle of the radius plays into a socket of the ulna; whilst below, that is, towards the wrist, the radius finds the socket, and the ulna the tubercle. A single bone of the fore-arm, with a ball and socket joint at the elbow, which admits of motion in all directions, might, in some degree, have answered the purpose of both moving the arm and turning the hand; but how much better it is accomplished by the present mechanism, any person may convince himself, who puts the ease and quickness with which he can shake his hand at the wrist circularly (moving likewise, if he pleases, his arm at the elbow at the same time), in competition with the comparatively slow and labouring motion with which his arm can be made to turn round at the shoulder by the aid of a ball and socket joint."

Admiring the beauty and simplicity of these contrivances, Mr. Editor, by which so complex a movement is effected, and having heard it often asserted, that nothing is created in vain, and no part of the human body without its use, I have often been puzzled to know for what purpose could be intended the *mammæ*, with which we see man and other male animals furnished, in all respects like those of females. Could they, by any possibility, effect the same purpose as with females? and is there found the same internal conformation and arrangement of parts; the same secreting vessels for affording the lacteous food, if brought into play? and can this be one of those admirable contrivances of Providence, held in reserve, to be called forth only in cases of accident to the mother, that the infant should not perish? These are questions which (in my ignorance of this part of the animal economy) I have frequently asked myself, and had never been able to solve satisfactorily, until the following confirmation of it met my eye in Captain Franklin's Arctic Tour, which, as it is extremely curious, and may serve to enlighten many of your readers on a subject so interesting to them, and on which they were before perhaps as ignorant as myself, I will give in Captain F.'s own words; or rather in those of Dr. Richardson (one of the gentlemen of the expedition), from whose journal he copied it.

" A young Chipewyan had separated from the rest of his band for the purpose of trenching beaver, when his wife, who was his sole companion, and in her first pregnancy, was seized with the pains of labour. She died on the third day after she had given birth to a boy. The husband was inconsolable, and vowed in his anguish never to take another wife; but his grief was in some degree abated, in anxiety for the fate of his infant son. To preserve its life, he descended to the office of nurse, so degrading in the eyes of a Chipewyan, as partaking of the duties of a woman.

"He swaddled it in soft moss, fed it with broth from the flesh of the deer, and to still its cries, applied it to his breast, praying earnestly to the great Master of Life to assist his endeavours. The force of the powerful passion by which he was actuated, produced the same effect in his case, as it had done in some others which are recorded—a flow of milk actually took place from his breast! He succeeded in rearing his child; taught him to be a hunter, and when he attained the age of manhood, chose him a wife from the tribe. The old man kept his vow, in never taking a second wife himself, but he delighted in tending his son's children, and when his daughter-in-law used to interfere, saying that it was not the occupation of a man, he was wont to reply, that he had promised the great Master of Life, if his child was spared, never to be proud, [illegible] the other Indians. He used to mention too, as a certain proof of the approbation of Providence, that although he was always obliged to carry his child on his back while hunting, yet that [illegible] never roused a mouse by its cries, being always particularly still at those times. Our informant (Mr. Wentzel, the guide to the expedition) added, that he had seen this Indian in his old age, and that his left breast, even then, retained the unusual size it had acquired in his occupation of nurse."

I don't know what the ladies will say to this, Mr. Editor, when they come to know that their husbands can be made so useful; and how droll I find it, that we male creatures should really possess the faculty of suckling our young, and should have remained so long in ignorance of it. As Dr. R. alludes to other cases upon record, I suppose there can be no doubt of the fact. I am afraid it will occasion quite a new era in domestic life, and that ladies will, in future, make it a condition of the marriage contract, that this duty shall be fairly divided with their husbands,—which, in a case of twins, I think would be but fair.

I remain, Mr. Editor,
Your very obedient humble servant,
G. H.

Leigh-street.

THE CHICKEN IN THE EGG.

NOTHING contributes more to the glory of the Creator than the observations made on the wisdom which appears in the production of animated beings. The less we are able to give an account of all his works, the more earnest we should be to seize every opportunity of attaining a knowledge of some of them at least. With this view, let us now consider the formation of the chicken in the egg. The hen has scarcely sat on the egg twelve hours, when there begins to appear some lineaments of the head and body of the chicken. The heart is seen to beat at the end of the second day; it has, at that time, the form of a horse-shoe, but no blood appears. At the end of 48 hours, two vesicles of blood can be distinguished, the pulsation of which is very visible; one is the left ventricle, the other the root of the great artery. At the fiftieth hour, one auricle of the heart appears, and resembles a noose folded down upon itself; the beating of the heart is first observed in the auricle, next in the ventricle. At the end of seventy hours, wings are perceptible; and on the head two bubbles for the brain, one for the bill, and two others for the fore part and hind part of the head. Towards the end of the fourth day, the two auricles already visible draw nearer to the heart than they did before; the auricle which appears first seems to have two horns, but it is afterwards found they are two auricles. The liver appears towards the fifth day. At the end of one hundred and thirty-eight hours, the lungs and stomach become visible; and at the end of a hundred and forty-two, the intestines, the loins, and the upper jaw. Two ventricles are seen at the hundred and forty-fourth hour; and two drops of blood instead of the single drop that was seen before. The seventh day, the brain, which was slimy, begins to have some consistence. At the hundred and ninetieth hour the bill opens, and flesh appears in the breast. At the hundred and ninety-fourth, the *sternum*, or breast-bone, is seen. At the two hundred and tenth hour, the ribs come out of the back, and the bill is very visible, as well as the gall-bladder. The bill becomes green at the end of two hundred and thirty-six hours, and if the chicken is taken out of its coverings, it evidently moves itself. Towards the two hundred and fiftieth hour the feathers begin to shoot out, and the skull becomes gristly. At the two hundred and sixty-fourth the eyes appear. At the two hundred and eighty-eighth the ribs are perfect. The spleen draws near the stomach, and the lungs approach the chest at the three hundred and thirty first hour. At the end of the three hundred and fifty-fifth, the bill frequently opens and shuts; and at the end of the four hundred and forty-first, or on the eighteenth day, the first cry of the chicken is heard. It afterwards gains more strength, and grows continually, till at last it sets itself at liberty by opening the prison in which it was shut up.

It is by so many degrees that these creatures are brought into life. All these progressions are made by rule; and there is not one of them without sufficient reason. If, for example, the liver is always formed towards the end of the fifth day, it is founded on the preceding situation of the chicken, and on the changes that were to follow. No part of the body could appear sooner.

S. H.

EFFECTS OF CARBONIC ACID GAS ON THE ATMOSPHERE.

To the Editor of the Mechanics' Register.

SIR,—I see in your Register (No. 79, page 360), Gmo. Henricus has again addressed me; allow me, therefore, to say two or three words to him in reply.

I deny that I have "garbled his statements," or that any garbling was necessary to establish my points, as opposed to his. But of this I leave your readers to judge; they have our letters, and if it be worth their while to favour them with a re-perusal, I think they will agree with me in this assertion.

Gmo. Henricus says, "There is still remaining a material point, on which I should wish to make a few observations, as it has occurred to me lately, that I have been misunderstood on it by your correspondent F. C., and that it is to this probably, I in some degree owe the opposition manifested by him." It is a pity he did not sooner discover this, since it would have saved him and me some trouble. But better late than never; and I am heartily pleased to find he no longer supports what I again declare to be a ridiculous opinion; viz., that the air is oftener deteriorated by excess of *oxygen* than by *fixed air.*

If I did not feel assured your readers by this time conceived something too much to be pleasing had been said upon this subject, I should certainly enlarge on it. But as it is, *I leave it finally*, by requesting Gmo. Henricus to turn to the Letter of Tyro, page 143 of the present volume of your

Register, from which he will find, that the greatest possible difference of opinion exists as to the action of plants on the atmosphere.

I remain, Sir,
Your very obedient servant,
F. C.

HOLLOWNESS OF THE EARTH.

To the Editor of the Mechanics' Register.

Sir,—It is well known that the weight of air increases in proportion as it is condensed by pressure. At the pressure of 1000 atmospheres, air becomes as heavy as water; so that at the depth of 10,000 yards from the surface of the sea, the former is equal in weight to the latter; and at the depth of 6 miles, air is heavier than water, so that the latter is capable of floating on the former. I am not aware to what degree air can be condensed, but if it has that property in an unlimited degree, we can easily perceive at what depth metals would float in the internal air. *Iron* would find its specific gravity at an equilibrium at the depth of 42 miles. Gold, likewise, would float at the depth of 120 miles, and platinum at 130 miles.

But as solids are in large masses mixed of various earths and metals, let us suppose their specific gravity 10, and their height above the level of the sea to be 3 miles; thus we find that their depth would not exceed 250 miles. Farther, the intensity of gravity decreases as we enter into the earth, as there is a re-action of attraction from the matter above, so that at the depth of 250 miles the medium of gravity is situated; the dense air below 250 miles becomes gradually rarefied, and at the depth of 500 miles it would be of the same specific gravity as water. Hence the depth from the waters on the exterior of the globe, to the waters in the interior [illegible] the globe, is about 500 miles. Had the earth been a chaos, mixed of earths, metals, water, and air, it would physically fall in the form of a shell, and the thickness of the shell would be according to the specific gravity of liquids or solids: for instance, had the specific gravity of the above-mentioned masses of solids been 5, instead of 10, the diameter of our globe would have been 12,000 miles in the room of 8000, and the thickness of the shell 250 miles; that is, from the waters of the exterior to the waters of the interior. I have assumed the specific gravity of solids as 10, for the sake of argument.

But if air has not the property of being condensed to the degree I have mentioned, the globe would not occur in the form of a shell, but would physically form itself into one solid mass to the centre of the globe. If we look to effects as a criterion, we should naturally conclude, from the convulsions that frequently occur, that there is some elastic medium extensively infused through the bowels of our globe, which penetrates the crevices and caverns of solids, so as to cause those stupendous phenomena called earthquakes. If the earth is a shell, as I have suggested, I am not aware whether the centrifugal motion that the globe has is adequate to cause an aperture at the poles, so as to open a communication from the exterior to the interior of the globe.

I am, Sir,
Your obedient servant,
David Thomas.

PRISMATIC COLOURS.

To the Editor of the Mechanics' Register.

Sir,—I was much gratified by the perusal, in your last Number, of an ingenious answer, from D. Thomas, to a query, suggested some time since, by G. H., concerning the production of the prismatic colours, by the smooth surface of glass. Being at present engaged in an experiment where glass is required to be highly magnified, these colours become, consequently, much increased, both in extent and vividness, and offer a very formidable impediment to my success. I hope, therefore, you will allow me to trespass a little on your valuable paper for further information, by the following inquiries; to which, if D. Thomas, or any other among your scientific contributors, will give a full and intelligent answer, they will greatly oblige me.

1.—Is there any method of destroying or counteracting this "refraction and refrangibility of rays" in glass, where they are found to exist?

2.—Is it possible to procure glass of any kind, as common plate glass, lenses, or reflectors, in which this refraction does not occur;—if it be, where, and under what name?

I remain yours, truly,

H. S.

MODE OF PRESERVING LIME-JUICE.

(Communicated to the Society of Arts by Captain T. M. Bagnold.)

It is well known that the juice of lemons, or of limes, expressed from the fruit, will, in a short time, especially if kept warm, become mouldy, and unfit for use as an article of food; and that the final result of this spontaneous change, is the destruction of the acid itself. The acid may, indeed, be separated from the other matters with which it is naturally mixed, but in so doing, all the odour and flavour of the native juice are also destroyed; for pure crystallized citric acid is wholly inodorous, and, to the taste, simply acid.

The effect of pure *citric acid*, in preventing or mitigating the severity of sea-scurvy, is greatly inferior to the recent juice; and in many of our circumnavigations, lemon or lime-juice, mixed with a small proportion of rum, about one-tenth, has been found to keep for a considerable time in tropical countries, and to be very efficacious in preserving the health of the crews. In some cases, however, this addition of spirit is by no means desirable.

In April, 1824, Captain Bagnold produced to the Committee a specimen of lime-juice, which had been prepared in Jamaica in the preceding September, according to his directions. The juice having been expressed from the fruit, was strained and put into quart bottles; these having been carefully corked, were put into a pan of cold water, which was then by degrees raised to the boiling-point. At that temperature it was kept for half an hour, and was then allowed to cool down to the temperature of the air. The process, therefore, was in substance, only the same as that which has been long practised in this country for preserving green gooseberries, and other fruits, for domestic use. A bottle being opened by the Committee, the juice was in the state of a whitish, turbid liquor, with the acidity, and much of the flavour of the lime; nor did it appear to have undergone any alteration.

In March, 1825, some of the same juice which had been examined the year before, and which had since only been again heated and carefully bottled, was laid before the Committee. It was still in good condition, retaining much of the flavour of the recent juice.

Hence, it appears, that by the application of the above process, the addition of rum, or other spirit, to lime or lemon-juice, may be avoided, without rendering it at all more liable to spontaneous alteration. *(Trans. Soc. Arts, Vol. XLIII.)*

TO CORRESPONDENTS.

T. M. B. need not have entertained any apprehension that his hint would be unacceptable; we shall willingly adopt it, whenever it is practicable; as a proof of which, we beg to inform him that the price of Dr. Wollaston's Camera Lucida does not exceed Thirty Shillings, or a Guinea and a half; and that of Mr. Hart's Instrument, described in the present Number, is (we believe) about Five Guineas. If it be of larger dimensions than the apparatus from which our drawings are taken, the expense must be proportionably greater.

Juvenis has our thanks for his good opinion. His answer to a query will be inserted, but the adoption of his suggestion would be attended with difficulties which he has not sufficiently considered.

The communications of "L'Ami des Sciences" have all been received, but the insertion of those which relate to astronomical subjects is unnecessary, as the same points will be fully illustrated in our reports of Mr. Wallis's Lectures. We are also of opinion that his quotation from Mr. Walker must be incorrect.

A. Peek will find an answer to his inquiry at page 175 of the present volume.

We are much obliged to S. H. for his communications, most of which are intended for insertion.

I. I. has quite mistaken his talent by attempting poetry.

W. Dowling will appear, as soon as we have room for his letter.

We cannot devote our pages to a discussion of the subject adverted to by a Member of the Rotherhithe and Bermondsey Mechanics' Institution; but if he will inform us where we can address a letter to him, we will give him our opinion.

Communications have been received from W. C.—A Young Beginner—H—y P—e—T. E. B., and several others, whose letters came too late for a more particular acknowledgment.

We must again request our Correspondents to transmit their favours for the current week by Tuesday at the latest.

THE LONDON

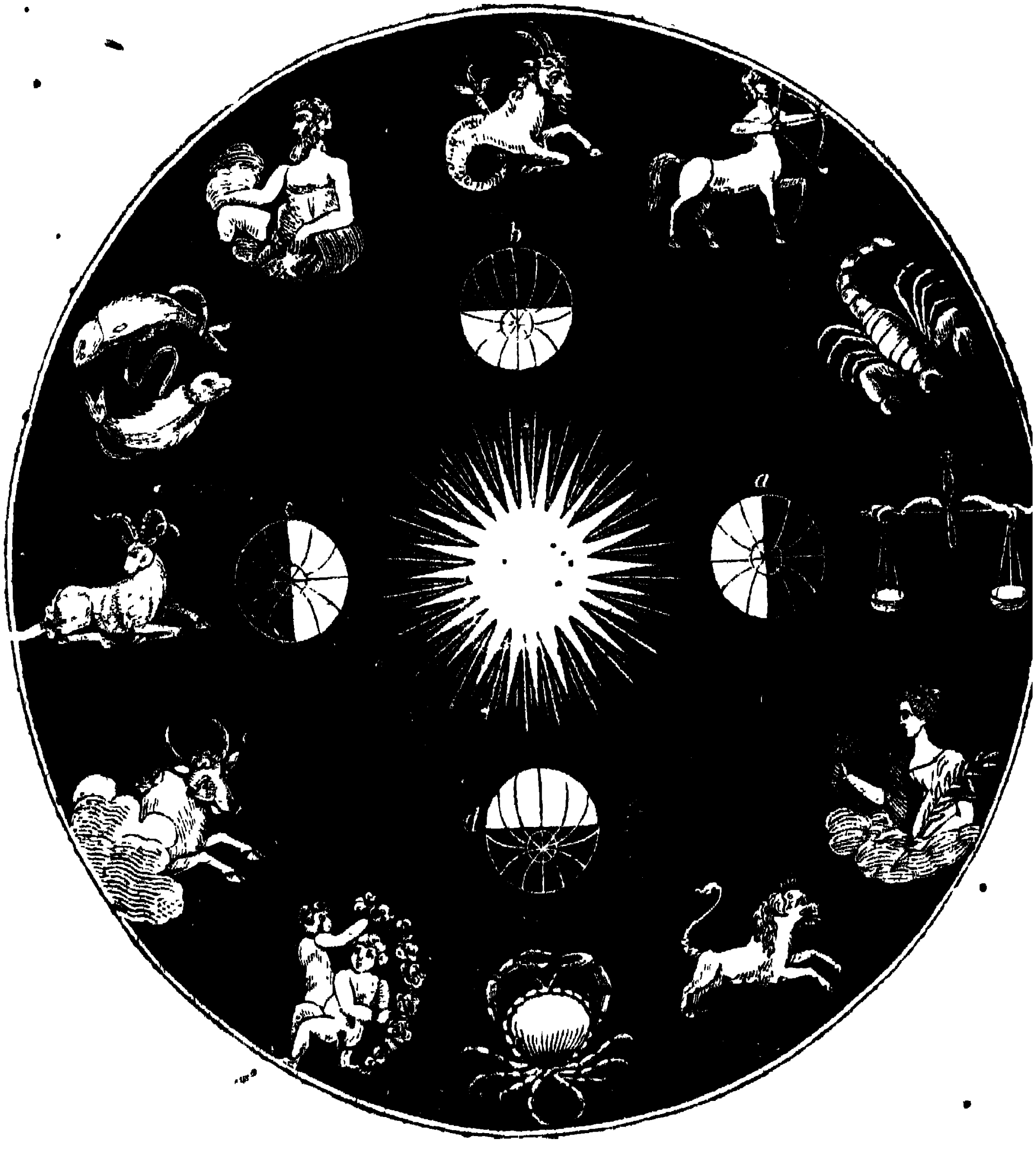
MECHANICS' REGISTER.

" And while the sun, ne'er covetous of rest,
Flies with such rapid speed from east to west,
In tracks oblique he through the ZODIAC rolls,
Between the northern and the southern poles,
From which revolving progress through the skies,
The needful SEASONS of the year arise."

BLACKMORE.

No. 82.] SATURDAY, APRIL 15, 1826. [Price 3d.

VIEW OF MR. WALLIS'S MAGNIFICENT VERTICAL TELLURIAN.



LONDON MECHANICS' INSTITUTION.

MR. WALLIS'S FIRST LECTURE ON ASTRONOMY.

INTRODUCTORY REMARKS ON THE HYPOTHETICAL NATURE OF ASTRONOMY—FORM OF THE EARTH—ITS DIURNAL AND ANNUAL MOTIONS—CENTRIFUGAL FORCE — EXPERIMENTAL ILLUSTRATION OF ITS EFFECT—DIMINISHED WEIGHT OF BODIES AT THE EQUATOR —THE PENDULUM — VICISSITUDES OF THE SEASONS — OBLIQUITY OF THE EARTH'S AXIS—LENGTH OF DAYS AND NIGHTS — VERTICAL TELLURIAN — SIGNS OF THE ZODIAC, &c.

WEDNESDAY, APRIL 5TH, AND FRIDAY, APRIL 7TH.

SUCH was the intense interest excited amongst the Members, by the astronomical talents of Mr. WALLIS, and the splendid Mechanical apparatus by which he illustrates the sublime science which formed the subject of his lectures, that, notwithstanding the judicious arrangement made by the Committee of Managers, in order to divide the attendance of the Members, the Theatre was completely thronged at an early hour, on each of the above evenings. The numerous pieces of mechanism employed by Mr. WALLIS, occupied the whole depth of the platform, and the curtains which concealed them, were extended across the Theatre, from gallery to gallery. Before the curtain, a temporary platform was erected, upon which stood a small table for the use of the Lecturer. The seats on each side of the lecture-table, usually occupied by the Committee and Donors, being thus rendered useless, a portion of the pit was railed off on one side for their accommodation. We have been told, that two or three of the Members expressed some dissatisfaction at this arrangement, but we are sure that a moment's consideration must convince them, that their objections were unreasonable. We were happy to observe among the audience, particularly on Friday evening, a considerable number of Ladies, who had been admitted by Visitors' tickets.

Many of our readers will recollect the reports we gave of the lectures delivered by Mr. WALLIS, nearly twelve months since, at the temporary lecture-room, in Monkwell Street. On that occasion we were unable, from a variety of causes, to introduce those illustrative diagrams, which so greatly facilitate the developement of the principles upon which the phenomena of Astronomy are elucidated; and having recently received numerous letters from our Subscribers, requesting us to give a full report of the present course, with suitable graphic illustrations, we readily comply with a request which, in fact, coincides completely with our own estimate of the importance of the subject. Mr. WALLIS's present lectures will be more extended, and his explanations, of course, more minute than upon the former occasion. Each lecture will also be delivered twice, and as the Lecturer's observations are entirely extemporaneous, it will necessarily happen, that some variation will result from the repetition, and that the same phenomena will frequently be illustrated by different facts. We shall avail ourselves of this circumstance, by attending on both evenings, and shall thus be enabled to render our reports more comprehensive, and to present our readers with a connected view of the whole of Mr. WALLIS's able remarks, illustrated by as many engravings as may be essential to a complete elucidation of the science.

Mr. WALLIS was greeted with reiterated cheers on entering the lecture-room; and as soon as the applause of the audience had subsided, he introduced his subject by observing, that the Members of the Institution were accustomed to receive instruction in those branches of Natural Philosophy which are susceptible of experimental and practical demonstration; but, as the Science which he should have the pleasure of submitting to their consideration could not be elucidated by that rigid species of evidence which is called *demonstrative*, he trusted that his hearers would excuse this imperfection, if it might be so termed, in a branch of physical science, as it would be found, that the principles of ASTRONOMY are supported by a combination of facts which give equal conclusiveness to the inferences necessarily resulting from them. When the Chemist performs an experiment, he is enabled to repeat one of the operations of Nature herself, and to avail himself of the actual elements, upon the combination or separation of which, depends the principle he is about to establish; but the proofs adduced by the Astronomer can only illustrate, without absolutely demonstrating, the sublime truths of the science. Astronomy is, therefore, entirely *hypothetical*, and, in this respect, it is not only distinguished, but contradistinguished from all other sciences. But notwithstanding this apparent disadvantage, if, instead of reasoning upon individual and isolated facts, we examine at one view, the accumulated proofs by which the principles of this science are illustrated, we shall find that these facts, taken together, will conduct us to conclusions scarcely less satisfactory than demonstration itself.

ASTRONOMY comprehends a knowledge of the distance and magnitudes of the heavenly bodies, with their motions, in their respective orbits; and it also includes several of the phenomena of our own planet, the Earth, which, like the other planets, is supposed to perform its revolution round the sun. In developing the laws by which the various motions of the planets are governed, it is necessary first to consider those physical principles with which we are acquainted, by our observations on the operations of nature on the surface of the earth; and, secondly, to apply these established principles to the facts which we observe in contemplating the motions of those bodies which are beyond our reach.

There is a wide distinction between *hypothesis* and *facts*; and it must not be supposed, because the astronomical predictions, founded upon the observation of certain facts, are fulfilled, that, therefore, the astronomical hypothesis is true; for our ancestors predicted occultations and eclipses, though their hypothesis was incorrect. It will be our business, in the present lecture, which must be considered as an introductory one, to lay before you some of those facts, which form the basis of the modern hypothesis; and it will be seen, that in so doing, we shall have to depend, in a great measure, on *analogy*; a mode of reasoning which is almost exploded in the illustration of physical science, but which must be admitted in Astronomy, because we cannot make direct experiments on the objects comprehended by this science. Men, in all ages, have been acquainted with the fact, that bodies fall towards the earth, and the cause of this constant effect has been called *attraction*. Now, it was only by an extensive application of this well-known fact, that Newton ascertained that the earth exercises a similar attraction on the moon. The reasoning by which he arrived at this conclusion was *analogical*, and it is to this species of evidence we must refer, in illustrating the great principles of the science of Astronomy.

Mr. WALLIS then adverted to the figure of the earth, and observed that, admitting the earth to be a planet, as we find that all the other planets are of a globular form, we have a right to conclude by analogy, that the earth is globular also; particularly when we witness the occurrence of phenomena which must necessarily result from its possessing such a form. Mr. Wallis here referred to Mr. Addison's large terrestrial globe, for the purpose of considering those phenomena which substantiate or invalidate the theory.

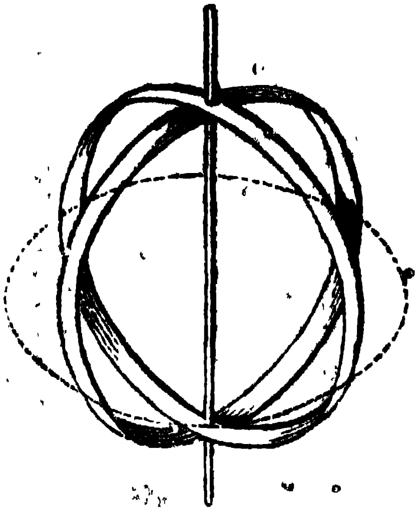
One of the most universal of all the phenomena of the celestial bodies, is their diurnal motion through the Heavens from East to West, and an attentive consideration of this fact ultimately leads to the conclusion, that the earth is globular. If we suppose this globe to represent the earth, and that it is turned on its axis from West to East, or in a direction contrary to that in which the stars appear to move, the effect, to an observer on its surface, would be precisely the same; for motion is merely a *relative idea*, and if it were possible that a man should be the only body in the universe, he would be unconscious of motion, with whatever velocity he might be impelled through space. The heavenly bodies are seen to rise constantly on the eastern side of the meridian of any place, and to set on the opposite or western side of the heavens. They do not, however, revolve round the *centre* of the earth, but round its *axis*, in circles parallel to the equator, and diminishing in magnitude from the equator to the poles, where they do not appear to have any revolution at all. This is one of the strongest arguments in support of the theory, that the apparent diurnal motion of the heavenly bodies round the earth is occasioned by the real motion of the latter round its own axis once in every 24 hours. Besides, it must be considered, that if the earth be immoveable, all the celestial bodies (of which we are acquainted with at least eighty millions, larger than our own planet) must move round the earth with degrees of velocity beyond the reach of human conception, in order to complete their journey in so short a space of time: for instance, the Moon must proceed at the rate of 1000 miles in every minute of time; the Sun must describe 400,000 miles in every minute, and the fixed Stars, from their immeasurable distance, must revolve millions of millions of times more rapidly than the Sun; all which improbabilities are got rid of by the simple hypothesis of the earth's revolution on its axis.

The planets Venus, Mars, Jupiter and Saturn, are known to revolve on their axes, by observations on the spots with which their surfaces are diversified. The revolution of Mercury has not been so distinctly ascertained, owing to its proximity to the Sun, and from the immense distance of the Georgium Sidus, no spots have yet been discovered on its disc; but it is supposed by analogy, that they revolve on their axes as well as the rest, and as they are all of a globular form, it is fair to conclude that the earth resembles them, both in its spherical form, and its revolution on its own axis.

It has been objected to this theory, that if the earth were in rapid rotation on its axis, a ball thrown perpendicularly into the air, would not fall into the hand of the person who threw it, but at some distance from him, because he must have been carried forward by the motion of the earth during its flight. To this, it may be answered that the motion of the person is communicated to the ball, which, therefore, describes a curve during its elevation and descent; a fact which is proved by expert horsemen, who find no difficulty in catching a ball thrown up when they are at full speed. A body at a considerable height must, however, describe a circle proportionably larger than if it were upon the surface of the earth, and as a further proof of the earth's revolution, it has been found by accurate experiment, that owing to this circumstance, a ball dropped from a very high tower does not strike the ground at a point exactly perpendicular to that from which it fell.

If, then, the revolution of the earth on its axis be admitted, it will follow as a natural consequence, that its figure is not exactly spherical; for the earth, being composed of an infinite number of particles, held together by their mutual attraction, will be acted upon by a contrary force when it is put in motion. This is called the *centrifugal force*, and its effect may be shewn in the following manner.

Fig. 2.



Mr. WALLIS here produced two flexible hoops, crossing each other at right angles, as shewn at fig. 2., and observed, that these hoops might be supposed to represent portions of the earth's surface. He then put them in rapid revolution, by twirling the perpendicular spindle, when the hoops almost immediately lost their circular shape, and revolved in the form represented by the dotted line. If, therefore, we suppose that the Almighty made the earth perfectly globular, the *centrifugal force* would cause it to become flattened at the poles, in a manner resembling the hoops in the above experiment, though in a less degree. It may be said, that the hoops are extremely flexible, and that the earth, from its solid nature, is not subject to the influence of such a force; but the earth is, in reality, sufficiently elastic to assume a spheroidal form by the operation of the centrifugal force. *Lead* is a very inelastic substance, yet two pieces of this metal, when struck against each other, will rebound; and the earth is supposed to be principally formed of *granite*, which is so elastic, that sound may be transmitted through it with great facility.

The effect of the centrifugal force is strikingly exemplified by the planets Jupiter and Saturn, which revolve on their axes with an amazingly rapid motion, and are, therefore, much more flattened at the poles than the earth. It must be observed, that the form of these planets, as well as of the earth, is that of an *oblate spheroid*, as they all revolve upon their *shorter axes*; and we shall now endeavour to shew experimentally, that all bodies, when put in revolution, must necessarily revolve upon their *shorter axes*, whatever may be their figure.

Mr. WALLIS here produced a flat piece of wood, of a *spheroidal* form, turning freely on a centre which was attached to a perpendicular rod. He first placed the spheroid in a slanting direction, and put it in revolution by twirling the wire; but it instantly changed its position, and revolved on its shortest axis. In this oblique position, it might be supposed, that the effect resulted from the parts of the spheroid not being in equilibrio, but when its longer axis was placed parallel to the perpendicular rod, the same effect took place, and it was evidently impossible to make the spheroid revolve on any other than its shorter axis.

In order to elucidate still more decisively the effect of the *centrifugal force*, the Lecturer performed several interesting experiments with an apparatus which is correctly represented in the following diagram (Fig. 3.), and which exhibits an extremely ingenious mechanical arrangement for producing a rapid *horizontal* revolution, by the motion of a *vertical* wheel.

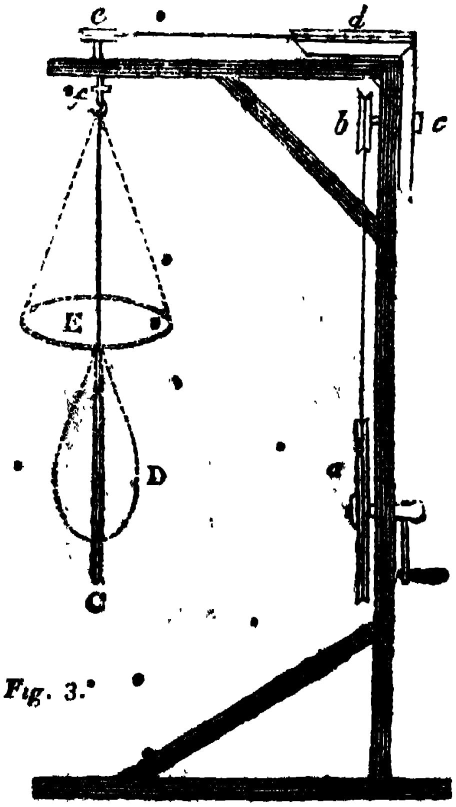


Fig. 3.

A slight inspection of the figure will be sufficient to shew the operation of the machine. When the vertical wheel *a* is turned, the endless cord which passes round it, turns the small wheel *b*, on the spindle of which is fixed the bevelled wheel *c*, on the exterior of the frame; the latter wheel communicates motion to the horizontal wheel *d*, which is connected by another endless cord to the small wheel *e*; and thus it is evident, that by turning the handle of the first wheel *a*, a very rapid revolution will be produced in any substance suspended from the hook *f*, which is turned by the wheel *e*.

To a cord attached to the hook *f*, Mr. WALLIS first suspended *by its edge*, a piece of wood in the form of an excessively *oblate spheroid*; its shorter diameter being to its longer in the proportion of about 1 to 6. Upon putting the spheriod in revolution, by turning the handle of the machine, it gradually quitted the position in which it was suspended by its longer axis, and in a few moments was seen rapidly spinning in a horizontal position. It may be supposed that in this experiment, a figure has been assumed, to which no body in nature bears an analogy, but this is not the case, for the planet Saturn affords a similar and much more striking example of the effects of the centrifugal force, as the exterior edge of his ring revolves at the rate of 90,000 feet in a second of time, and therefore possesses a motion, infinitely more rapid than any that we can produce by mechanical means. A correct model of this magnificent planet was attached to the cord, *by the edge* of its ring; but, like the spheroid in the preceding experiment, it was almost immediately seen in rapid motion on its *shorter axis*.

When we perceive the smallest, and the most magnificent operations of nature bound together by the agency of one inflexible law, upon whose inviolableness the existence and enjoyment of millions of sentient and intelligent beings depend—surely, the simplicity and unity of the creation speaks His wisdom who formed and governs the whole; and when contemplating the sublime demonstrations of this attribute, which are unfolded by Astronomy, it is as foolish as it is impious to reject this evidence of the Almighty's providence—to borrow the language of a Hebrew poet, "It is the fool which hath said in his heart there is no GOD."

A third experiment, which appeared to us to exhibit a still more remarkable instance of the effects of centrifugal power, was performed by suspending to the cord an endless chain C. (Vide Fig. 3.) Upon turning the machine, the chain diverged into the form represented by the dotted line D, and after a number of curious gyrations, it ultimately revolved rapidly in a horizontal position, as at E, while the cord, from the velocity with which it was carried round, assumed the form of a cone, with the chain for its base. To shew the effect of the experiment more distinctly, Mr. WALLIS held a lighted lamp within the horizontal circle formed by the chain. The lecturer finally suspended to the machine, by its *longer* or *equatorial axis*, a large *oblate spheroid*, representing the earth, though its proportions were greatly exaggerated, and this spheroid, notwithstanding its size, very soon obeyed the universal law of nature, by revolving rapidly on its *polar*, or *shorter diameter*.

In addition to these facts, which demonstrate the theory of the earth's *oblate spheroidal* form, it has been ascertained, by actual measurement, that its *equatorial* exceeds its *polar* diameter by about 36 miles. But there is another point of very considerable importance connected with the figure of the earth, and the centrifugal force produced by its revolution on its axis. At the equator, the surface of the earth revolves at the rate of 1000 miles an hour; but this velocity decreases from the equator to the poles. In the latitude of London, the velocity of the earth's revolution does not exceed 500 miles an hour, and at the poles it has no motion. Now the weight of bodies is their tendency to fall towards the centre of the earth by the influence of *gravitation;* and as the centrifugal force acts in direct opposition to the force of gravitation, it may naturally be expected that at the equator, where the centrifugal force is the strongest, the weight of bodies will not be so great as in other parts of the earth. But there is a difficulty attached to the demonstration of this fact, because if a pound of lead be weighed against any other substance in the latitude of London, they would be in equipoise at the equator, because the weight of each would be equally diminished. This difficulty is, however, obviated by the *pendulum,* the oscillations of which are produced by its tendency to fall, like all other bodies, towards the centre of the earth. The fall of the pendulum to the earth is prevented by the string or rod which supports it, and it therefore vibrates backwards and forwards. But if, by the force of *gravitation*, it oscillates with a given velocity in the latitude of London, it must be evident that at the equator, where the *centrifugal force* which opposes *gravitation,* operates with double power, the pendulum will fall with a diminished force, and will oscillate more slowly, or make a less number of oscillations in any given time. This is found to be the case by actual experiment, and these accumulated facts amount to a demonstration of the revolution of the earth on its axis.

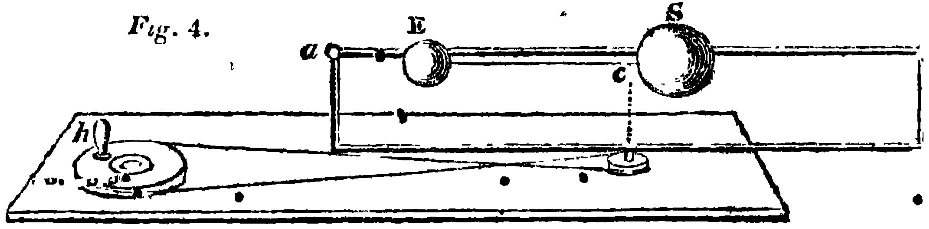
From a calculation of the power of the *centrifugal force,* as compared with that of *gravitation,* mathematicians are enabled to ascertain the exact point at which the two forces would counterbalance each other; and it appears by their calculations, that if the earth revolved on its axis in 84 minutes, instead of 24 hours, the *centrifugal* and *gravitating* forces would be in equilibrio at the equator, where bodies, under those circumstances, would weigh *nothing*; and if the velocity of the earth's motion was further increased, they would fly off from its surface.

To shew the effect of the centrifugal force, when carried to the extreme, Mr. Wallis attached to the *whirling-table* (represented at fig. 4), two glass tubes, containing some *leaden shot*, *water*, and *air*. These tubes were placed in an oblique direction from the points *a* and *b*, to the centre of the revolving quadrangle, and before the apparatus was put in motion, the different substances occupied their natural situation; the air occupying the upper part of the tubes, the water the middle, and the shot the bottom. But when the tubes were put in rapid revolution, the force of gravitation was completely overcome, and the order in which the three bodies had been arranged was reversed; the shot being at the top, the water in the middle, and the air at the bottom.

Another phenomenon observable in the heavens is the apparent motion of the sun, from West to East, amongst the stars. If we notice any particular star exactly in the meridian, at 10 o'clock at night for instance, when the sun is to the West of the star, and continue to watch the same star night after night, at the same hour, we shall find that its distance from the sun gradually decreases, till the latter hides it from our view; after which, it re-appears on the Western side of the sun. This apparent motion of the sun through the heavens is completed in 365 days, and it is therefore evident, either that the sun revolves round the earth in that period, or the earth round the sun. But the mass of the sun is found to be 300,000 times as great as that of the earth, and, besides that the motion of the earth round the sun is in perfect conformity with the simplicity of all the operations of nature, it may be demonstrated, on mechanical principles, that it is impossible to make a smaller body revolve round a larger.

Mr. Wallis then suspended two balls of different sizes, connected together by a wire (as at S and E, fig. 4), by fastening a thread to the wire at the point *c*, which was the exact centre of gravity between the two balls. In this situation they were put in revolution, and it was seen that the smaller ball, E, revolved round the larger ball, S, while both revolved round their common centre of gravity, *c*. To shew more clearly the impossibility of making the ball S revolve round the ball E, the two balls were attached to the whirling-table, as shewn in the following figure; the wire *a b* passing through holes in the balls, so that they were at liberty to move freely backwards and forwards upon it.

Fig. 4.

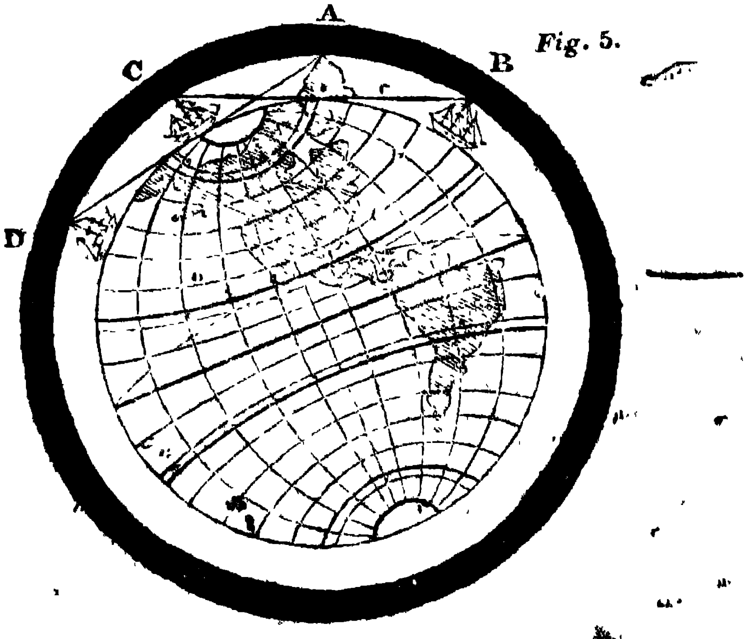


The ball E was first placed in the apparatus at *c*, but upon putting the whirling-table in motion, by turning the handle *h*, the balls instantly flew to the extremity of the wire, and would have been thrown off if they had not been stopped. The same effect took place when the larger ball, S, was placed at *c*, as it was found impossible to make the smaller ball revolve round its centre; but when the balls were placed as in the figure, so that their common *centre of gravity* coincided with the *centre of motion*, they discovered no disposition to quit their relative situation, however rapidly the machine was whirled, though they were as free to move along the wire as before.

Applying this principle to the sun and the earth, it is inferred that the latter must revolve round the former, while both move round the centre of gravity common to the two bodies. The result of the revolution of the earth on its axis, and its motion in its orbit round the sun, together with the obliquity of the earth's axis to the plane of its orbit, is what we call the vicissitudes of the seasons, and the different lengths of our days and nights. To exemplify these phenomena, Mr. Wallis exhibited a *horizontal tellurian*, in the centre of which was placed a lamp, representing the sun, and the Theatre being darkened, the light of the lamp was thrown upon a small globe, of which it of course illuminated exactly half. When the axis of this globe was placed *perpendicular* to the plane of the orbit in which it was made to revolve, the *terminator*, or boundary line of light and darkness, passed through the two poles, in whatever part of the orbit the globe was situated, and the days and nights were equal in all parts of the world. But when the Lecturer placed the globe in an *oblique* direction, so that its axis, as in nature, formed an angle of 23½° with the plane of its orbit, it was seen that this equality in the length of the days and nights, can only occur twice in the year, viz., on the 21st of March and the 23d of September. Mr. Wallis then directed the revolution of the globe through the whole of its orbit, commencing with the *vernal equinox* on the 21st of March, and proceeding to the *summer solstice*, which occurs on the 21st of June, when the days are at the longest in our latitude, and the North Polar regions are constantly enlightened by the sun. On arriving at the period of the *autumnal equinox*, on the 23d of September, the *terminator* again passed exactly through the poles, and the days and nights were again equal all over the world; but the length of the days diminished in the Northern hemisphere till the globe reached the *winter solstice*, on the 21st of December, when the North Pole is in darkness from September till March, and the shortest day occurs in the latitude of London. The days then progressively increased in length, till the globe again reached its first situation at the *vernal equinox*. At the equator, the days and nights are constantly equal; but in all other parts of the earth, the continual variation in the periods during which they experience the light and heat of the sun, produces all the phenomena which attend the vicissitudes of the seasons.

Mr. Wallis then withdrew for a few moments, and, on his return, exhibited a beautiful transparency, representing the earth as it would appear to a spectator placed at the distance of thousands of miles. The following diagram (fig. 5), will convey a correct idea of this transparency:—

Fig. 5.



In his remarks upon this diagram, Mr. Wallis took occasion to exemplify the spherical form of the earth, by causing a small vessel to move round a portion of the earth's surface, as shewn in the figure. If a spectator be situated at the *foot* of the mountain A, while the vessel at B is approaching towards him, the mast of the vessel will become visible first, and it will appear to rise out of the water till the whole of it is seen. When the vessel has passed the mountain, it will gradually sink below the horizon of the spectator, the lower parts disappearing first, till it arrives at C, when it will be entirely hidden from his view. But the whole of the vessel will still be visible to an observer on the *summit* of the mountain, who will not lose sight of it completely, till it has reached the situation represented at D.

Mr. Wallis observed, all bodies are attracted towards the centre of the earth, because a diameter, or line passing through its centre, is the longest, that can be drawn; and as the greatest number of the particles of which the earth is composed lie in that direction, its attraction must, of course, be most powerful in the same line. Thus all bodies on the surface of the earth possess a tendency towards its centre, and have weight with reference to its attraction; but a body placed exactly at the centre of the earth would have no weight, because it would be attracted equally in every direction. If it were possible to form a tunnel completely through the earth, a ball dropt into it would fall to the centre by its gravity, and would be carried to the opposite surface by the momentum it had acquired during its fall. It would then return in the same manner to its first situation, and continue to oscillate for ever, provided the tunnel were a perfect vacuum, so that no *resistance* was encountered by the ball. But if the tunnel were filled with air, the resisting medium would cause the oscillations of the ball to decrease in length at every vibration, till it ultimately remained without weight at the centre of the earth. The earth, though it is the cause of weight in other bodies, possesses no weight itself; for all weight must necessarily terminate at the centre, and if the earth were alone in space, the slightest force would be sufficient to move its whole mass.

Mr. Wallis again withdrew, for the purpose of putting in motion the admirable machinery of his magnificent *vertical tellurian*, which in a few minutes was exhibited to the audience in all its splendour, and elicited loud and long continued applause. We have endeavoured, in our frontispiece, to give a correct representation of this beautiful transparency, but it must be seen, in order to be justly appreciated. The earth was seen revolving round the sun, which, to a spectator on its surface, appeared to pass successively through the twelve signs of the zodiac in the course of the year; and as the axis of the earth was inclined to the plane of its orbit, and remained parallel to itself throughout the whole circuit, the different situations of the terminator, which had been previously shewn by the *horizontal tellurian*, were now exhibited with increased effect in another manner. When the earth is at *a*, and the sun appears in the opposite constellation, *Aries*, the terminator passes exactly through the poles, and the days and nights are equal, as on the 21st of March. At *b*, the sun appears in the sign *Cancer*, and the terminator passing about 23½° beyond the North Pole, the whole of the polar regions to this extent are illuminated, and our longest day occurs on the 21st of June. At *c*, on the 23d of September, the days and nights are again equal, and the sun is in *Libra*; and when the earth arrives at *d*, on the 21st of December, the sun is seen in *Capricorn*, the North Polar regions are involved in darkness, and the shortest day occurs in our latitude. At the equator, the days and nights are always equal, because the terminator and the equator are both *great circles*, and constantly *bisect* each other.

Mr. Wallis concluded, by stating that, in his next lecture, he should illustrate the phenomena of the Moon, and he withdrew amidst the acclamations of the crowded assembly, among whom we observed, on Friday evening, the celebrated Neapolitan, General Pepe, in company with Dr. Gilchrist and his lady.

LECTURES FOR NEXT WEEK.

Wednesday, April 19, MR. WALLIS'S Third Lecture on Astronomy.

Friday, April 21, the same Lecture repeated.

INTRODUCTION TO THE STUDY OF BOTANY.

(Continued from Page 378).

CLASS 9. ENNEANDRIA.—*Nine* Stamens.

It contains only one order.

70. *Hexagynia*—six pistils.—There is only one plant, the *butomus*, flowering-rush, of one species, the *butomus umbellatus*, a most beautiful flower of a rose colour. It grows in ditches, and on the margins of rivers, flowering about June. The leaves are radical, upright, narrow, and nearly a yard high; the stem still taller, is leafless, bearing a large umbel, with several leaves at its base, called the *involucrum*. Each flower has six ovate petals, the three outermost smallest and most pointed: the stamens are nine, and shorter than the corolla, supporting oblong anthers; the pistils are six.

In this class, there are many valuable

exotics—among which are the cinnamon and camphor trees.

CLASS 10. DECANDRIA.

The tenth botanical class is distinguished by the stamens being ten. Its orders are four.

71. 1. *Monogynia*—one pistil.—We have here *monotropa*, bird's nest, a *paracitical* plant—that is, instead of growing in the ground, it is fixed on the roots of beeches and firs—but not frequently met with. The flowers grow in a drooping cluster; the lateral ones having eight stamens: but since the terminal one has *ten* stamens, the genus is put in this class.

72. *Andromeda*, andromeda, an elegant evergreen shrub, with pale drooping flowers, narrow leaves, of a dark green colour, and glaucous beneath—that is, " clothed with a fine sea-green mealiness which easily rubs off."

73. *Arbutus*, strawberry-tree, with pale greenish flowers of one petal, divided into five small blunt segments. It is a bushy tree easily distinguished by the red berries, like strawberries, hanging on at the same time as the flowers, for they require twelve months to arrive at perfection.

74. *Pyrola*, winter green. Most of the species of this genus are very pretty flowers, either white or reddish, growing on tall upright stalks; the petals, five in number, are roundish and spreading, containing ten stamens, with large pendulous *anthers*, each of which, on examination, will be found two-celled.

75. 2. *Digynia*—two pistils—contains *saxifraga*, saxifrage, one species, called the *London-pride*, is generally known, and will serve to distinguish the other species. On examining, the calyx will be found to consist of one leaf, cut into *five* deep segments, and the petals, five in number, attached to it; the *capsule*, which I have frequently described as the *enlarged germen*, to be armed with two beaks formed of the permanent styles, and the seeds minute and numerous.

76. *Scleranthus*, knarvel: this flower has no corolla, but a calyx of one leaf, divided into five deep segments, in which is contained a single seed.

77. *Saponaria*, soap-wort, has a calyx of one leaf, five reddish petals, and leaves with three ribs.

78. *Dianthus*, pink, known to every one. The petals, five in number, are attached to the *receptacle*; the calyx of one leaf, is tubular with scales at the base, which distinguishes it from any other flowers in this order; and the leaves are *linear* (see Par. 24) and opposite.

79. 3. *Tryginia*, three pistils—contains *Silene*, catchfly or campion, a large genus of plants, distinguished by having five petals with *claws* (see Par. 4.) as long as the calyx, and by the calyx being of one leaf, cut into five marginal teeth—the flowers are either red or white.

80. *Stellaria*, stitchwort, one species, the common chickweed, is known to us all. It flowers from March to November, and I have one before me at the present moment; the number of stamens is very variable, either three, five, or ten; the one I hold in my hand was found in the garden, where it is considered as a weed, and which contains three stamens and three pistils, on a nearly globular capsule; the petals, five in number, and white, are so deeply cut, as to have the appearance of being ten; and the calyx consists of five leaves.

81. 4. *Pentagynia*—five pistils. Here is the *oxalis*, wood-sorrel; one species, oxalis *acetosella*, found in blossom during April and May, in shady places, indeed, abundant almost every where, I will describe, it being a most elegant flower, and easily procured—and here I cannot too particularly recommend the young botanist to compare the description with the plant; by so doing, he will soon become familiar with the terms. I believe I have not yet mentioned that the first word of the name of a plant was the *generic* name, and the last the *specific*; thus, the *generic* characters of *oxalis*, are a corolla of five petals, much longer than the calyx, and joined at their base by means of their claws; an angular capsule with five cells, and two seeds, each seated on an elastic *tunic*. The *specific* characters of the oxalis acetosella are—radical stalks, each bearing a single flower, either white or purplish, ternate leaves, heart-shaped,

and having a *bulbous* root of many scaly joints. The following are the *full* characters.—There is no stem. The leaflets are of a bright green; sometimes of a purple colour at the back, growing on long, hairy, purplish *foot-stalks*, as the leaf-stalk, or petiole, is sometimes called. The peduncles, or flower-stalks, are taller than the petioles, with two *bracteas* (see Par. 1), some distance below the top of each of them. The flower is bell-shaped, and drooping; the calyx consists of five deep, acute segments: the filaments of the stamens are erect, the three outermost shortest, supporting roundish anthers; the pistils are five, with blunt stigmas. The seeds, when ripe, are projected to some distance on the slightest touch.—The whole herb possesses a most agreeable acid taste.

82. *Cerastium*, mouse-ear chickweed, greatly resembles the *stellaria*, and is difficult to distinguish from it.

83. *Spergula*, spurrey, is distinguished from the last genus by the petals being undivided, and the capsule having five valves.

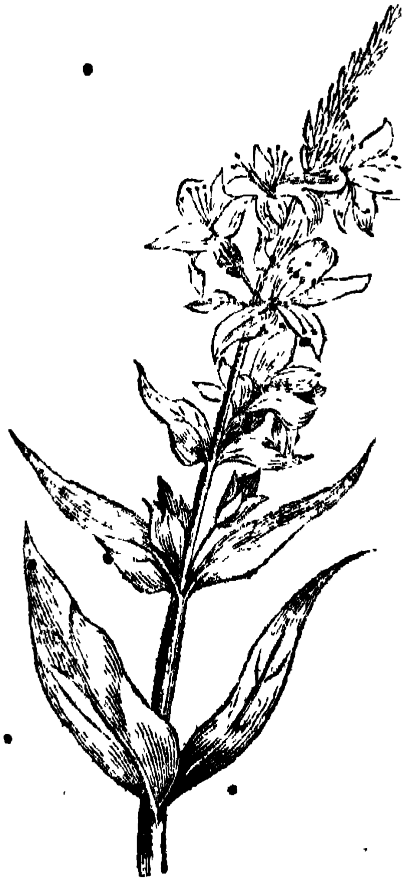
Class 11. Dodecandria.

84. The number of stamens in this class is uncertain, it contains all those plants which have from eleven to nineteen stamens in each flower. It contains four orders.

85. 1. *Monogynia*. We have here the *asarum*, asarabacca, a flower with a greenish purple calyx, of one leaf, with three rather deep segments, without any corolla. The leaves are of a dark green, *kidney-shaped*, two growing on each stem.

86. Here is the genus *lythrum*, willow herb, or more properly purple-loosestrife: one species, growing abundantly in watery places, with elegant purple flowers, I select as an example of this class. The flowers grow on long leafy *spikes*, without any scent.* The calyx is hairy, with about twelve teeth or notches—six long, and the others very small; the long spreading petals generally six, are fixed on the rim of the calyx; the stamens are twelve. The smooth stem is generally three or four feet high, erect and square. The leaves are long and slender towards the top, but heart-shaped at the base; most frequently are opposite to each other; occasionally alternate, without any leaf-stalk, therefore are *sessile*. The flowers, nearly sessile, grow from the angle formed between the leaves and the stem, which angle is called the *axilla*: hence the flower is said to be *axillary*. In this description we recognise the lythrum *salicaria*. (See fig. 7.)

Fig. 7.



87. 2. *Digynia*—two pistils. We have in this order only one plant, *agrimonia*, agrimony, growing on the side of roads, and the borders of hedges. The flowers of this aromatic herb are numerous, *spiked*, and of a brilliant yellow; the calyx is encompassed with bristles; the corolla consists of five petals borne by the calyx, and the two seeds lie at the bottom of the hardened calyx. The leaves are

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* A *spike* consists of a stalk, which supports a number of flowers, joined to it without a peduncle,—in other words, the flowers are sessile. (See fig. 7, where all the flowers are not quite sessile, though they are still said to be *spiked*.)

interruptedly pinnate—that is, a number of leaves grow on both sides of the peticle or leaf-stalk, therefore, they are called *pinnate* leaves; but there are various small intermediate ones; hence the term *interruptedly* pinnate.

88. 3. *Trigynia*—three pistils—only one genus, the *reseda*, rocket. There are two species, which will be easily distinguished from their greatly resembling the foreign species, known to us under the name of *mignionette*, though without the scent. The flowers are said to be *racemose*, not spiked, because, instead of being sessile, they are joined to the common stalk by means of partial peduncles; thus forming a raceme. Examining a mignionette, will immediately explain.

89. *Sempervivum*, house-leek, so abundant on walls and cottage roofs. The calyx consists of one leaf, cut into an uncertain number of segments, varying from one to twenty-four—generally, the stamens, pistils, and petals are of a similar number. The flowers are large, of a pale rose colour, without scent, on the top of a stem about a foot high, which arises from the centre of a tuft of fringed leaves crowning the fibrous root, the flowers there forming a sort of *cyme*. (See Par. 47.) The stem, however, is clothed by other leaves, more narrow than those at the base, and likewise sessile.

90. *Euphorbia*. This is a shrubby plant, and when one of the species is once seen, any other will be immediately recognized. The plants abound with a milky juice, possessed of so much acrimony as to erode the skin, when touched by it. This juice was once much used as a medicine, but on account of the violence of its effects, it is now seldom used as an internal remedy.

Rye. TYRO.

(To be continued.)

METHOD OF FORMING HALOES ARTIFICIALLY.

To the Editor of the Mechanics' Register.

SIR,—The following experiment, which illustrates in a pleasing manner the actual formation of *haloes* round the sun, or any luminous object, has been given by Dr. Brewster, which, if you think it worth inserting, is much at the service of your readers.

Yours, &c.

J. DAVY.

Cambridge Heath, Hackney.

"TAKE a saturated solution of *alum*, and having spread a few drops of it over a plate of glass, it will rapidly crystallise in small, flat octohedrons, scarcely visible to the eye. When the plate is held between the observer and the sun, or a candle, with the eye very close to the smooth side of the glass-plate, there will be seen three beautiful haloes of light, at different distances from the luminous body. The innermost halo, which is the whitest, is formed by the images refracted by a pair of faces of the octohedral crystals, not much inclined to each other. The second halo, which is more coloured, with the blue rays outwards, is formed by a pair of faces more inclined; and the third halo, which is very large and highly coloured, is formed by a still more inclined pair of faces.

"Each separate crystal forms three images of the luminous body, placed at points 120° distant from each other, in all the three haloes; and as the numerous small crystals have their refracting faces turned in every possible direction, the whole circumference of the haloes will be completely filled up.

"The same effects may be obtained with other crystals, and when they have the property of *double refraction*, each halo will be either doubled, when the double refraction is considerable, or rendered broader, and otherwise modified in point of colour, when the double refraction is small. The effects may be curiously varied, by crystallising, upon the same plate of glass, crystals of a decided colour, by which means we should have white and coloured haloes succeeding each other."

SAFETY FOR LOADED FIRE-ARMS.

SIR,—In answer to W. B.'s suggestion, given in the Register, p. 364, I beg leave through your excellent publication to observe, that the old method of preventing accidents by loaded fire-arms, viz. by writing on a card attached to the instrument the word "Loaded," has been found not a sufficient preventive; for I need hardly observe, children, (who are generally the cause of such disasters,) are not all able to read, and if they were, there would not be caution enough used by reading it.

I would therefore humbly beg to suggest, that it would be extremely advantageous if an ingenious piece of mechanism were invented, similar to "Bramah's Lock," and made applicable to the lock of fire arms, so that the individual *alone* could discharge it, who had "set" it.

I have a lock called a stop-lock, which is very useful in preventing accidents in forests, but the other proposed would prevent the *murderous* use, as well as the *incautious* use of fire-arms.

I remain,
Your constant reader,
J. H.

FORMATION OF CORAL REEFS.*

The examination of a coral reef, during the different stages of one tide, is peculiarly interesting. When the tide has left it for some time it becomes dry, and appears to be a compact rock, exceedingly hard and rugged; but as the tide rises, and the waves begin to wash over it, the coral worms protrude themselves from holes which were before invisible. These animals are of great variety of shapes and sizes, and in such prodigious numbers, that in a short time the whole surface of the rock appears to be alive and in motion. The most common worm is in the form of a star, with arms from four to six inches long, which are moved about with a rapid motion in all directions, probably to catch food. Others are so sluggish, that they may be mistaken for pieces of the rock, and are generally of a dark colour, and from four to five inches long, and two or three round. When the coral is broken about high water mark, it is a solid hard stone; but if any part of it be detached from a spot which the tide reaches every day, it is found to be full of worms of different lengths and colours, some being as fine as thread, and several feet long, of a bright yellow, and sometimes of a blue colour; some resemble snails, and some are not unlike lobsters in shape, but soft, and not above two inches long. The growth of coral seems to cease when the worm is no longer exposed to the washing of the sea. Thus, a reef rises in the form of a cauliflower, till its top has gained the level of the highest tides, above which the worm has no power to advance, and the reef, of course, extends itself upwards. The other parts in succession reach the surface, and there stop, forming, in time, a level field, with steep sides all round. The reef, however, still increases; and being prevented from growing higher, extends itself laterally in all directions. But this growth being as rapid at the upper edge as it is lower down, the steepness of the face of the reef is still preserved. These are the circumstances which render coral reefs so dangerous in navigation; for in the first place, they are seldom seen above the water, and in the next, their sides are so steep, that a ship's bows may strike against the rock before any change of soundings has given warning of the danger.

S. H.

OBSERVATIONS ON THE TELESCOPE.

(*By Mr. Dick, of Perth.*)

"The telescope may be considered as serving the purpose of a vehicle for conveying us to the distant regions of space. We should consider it as a wonderful achievement, could we transport ourselves two hundred thousand miles from the earth, in the direction of the moon, in order to take a nearer view of that celestial orb. But this instrument enables us to take a much nearer view of that planet, than if we had actually surmounted the force of gravitation, traversed the voids of space, and left the earth 230,000 miles behind us. For, supposing such a journey to have been accomplished, we should still have been ten thousand miles distant from that orb. But a telescope which magnifies objects 240 times, can carry our views within ONE thousand miles of the moon; and a telescope, such as Dr. Herschel's 40 feet reflector, which magnifies 6000 times, would enable us to view the mountains and vales of the moon, as if we were transported to a point within 50 miles of her surface. We can view the magnificent system of the planet Saturn, by means of this instrument, as distinctly as if we had performed a journey eight hundred millions of miles in the direction of that globe, which, at the rate of 50 miles an hour, would require a period of more than eighteen hundred years to accomplish. By the telescope, we can contemplate the regions of the fixed stars, their arrangement into systems, and their immense numbers, with the same distinctness and amplitude of view, as if we had actually taken a flight of ten hundred thousand millions of miles, into those unexplored and unexplorable regions, which could not be accomplished in several millions of years, though our motion were as rapid as a ball projected from a loaded cannon. We should justly consider it as a noble endowment for enabling us to take an extensive survey of the works of God, if we had the faculty of transporting ourselves to such immense distances from the sphere we now occupy; but, by means of the telescope tube, we may take nearly the same ample views of the dominions of the Creator, without stirring a foot from the limits of our terrestrial abode. This instrument may, therefore, be considered as a providential gift bestowed upon mankind, to serve, in the mean time, as a *temporary substitute* for those powers of rapid flight with which the seraphim are endowed, and for those superior faculties of motion with which man himself may be invested, when he arrives at the summit of moral perfection."

LABOURS OF THE SILK WORM.

THE whole moth-kind, as well as the silk-worm, immediately before their transformation into the chrysalis state, cover their bodies with a cocoon or clew of silk; though the nature of their silk and their mode of spinning are very different. The cocoons of the silk-worm are composed of pure silk. Their figure is generally oval, which necessarily results from that of the animal's body upon which they are moulded. When spinning, they twist their bodies into the form of an S. The cocoon is produced by numberless circumvolutions and zig-zags of the same thread; the silk is spun by an instrument situated near the mouth of the insect. The silky matter, before it is manufactured by the spinning instrument, appears under the form of a gum almost liquid, which is contained in two large reservoirs, contorted like the intestines of larger animals; and which terminate at the spinning instrument by two parallel and slender conduits: each conduit furnishes matter for one thread. The spinning instrument, as is evident when viewed by the microscope, unites the two threads into one. Thus a thread of silk which has the appearance of being *single*, is in reality *double*, and spun with great dexterity. Some writers who delight in the marvellous, ascribe foresight to the silk-worm in spinning its cocoon. The silk-worm, it must be acknowledged, acts as if it foresaw the approaching event. But the truth is, that when the animal has acquired its full growth, its reservoirs of silk are completely filled. It then seems to be strongly stimulated to evacuate this glutinous matter. Its different movements and attitudes while discharging the silk, produce those oval bundles, which clothe and ornament vast numbers of the human species.—*Scientific Gazette.*

ELECTRICAL INQUIRIES.

To the Editor of the Mechanics' Register.

MR. EDITOR,—Not being a proficient in Electricity, and not having access to apparatus by which I might satisfy my doubts, I have taken the liberty of sending a few ideas for insertion, hoping some of your intelligent correspondents will give me the information I desire.

Is not the electricity with which a jar is charged generated by the friction of the rubber on the cylinder? Is it satisfactorily ascertained, that there is no more electricity in the jar after it is charged than before; the charged jar being *plus* inside, and *minus* outside? If that is correct, in what manner does the machine act in conveying it? Can a jar be charged in any way when insulated?—I should say that there was the *natural portion* of electricity on the outside of a jar when charged, with a redundancy within, but not being a philosopher, I cannot determine. Is it not possible that there is an atmosphere of electricity around us, and that it is (if I may so call it) the *rare principle* of all bodies; being to air, if I might make the comparison, what air is to a solid body. Is there not a connection between *light* and *electricity*? Is it not possible, that a thunder-cloud, possessing a strong affinity for the electric fluid, attracts it from the atmosphere, and coming within the influence of a still stronger attraction, discharges it? If there should appear to your electrical correspondents any inconsistency in the above ideas, I must request them not to be too severe on

T. E. B.

MANAGEMENT OF BEES IN EGYPT.

Upper Egypt preserving its verdure only four or five months, the flowers and harvest being seen no longer, the people of the lower Egypt profit by this circumstance, assembling on board large boats the bees of different villages. Each proprietor confides his hives, with his own mark, to the boatman, who, when loaded, gently proceeds up the river, and stops at every place where he finds verdure and flowers. The bees swarm from their cells at break of day, and collect their nectar returning several times loaded with booty, and in the evening re-enter their hives without ever mistaking their abode. Thus sojourning three months on the Nile, having exhausted the perfume of the orange-flowers of the *Said*, the essence of the roses of Faycum, the sweets of the Arabian jasmine, and of every other flower; the bees are brought back to their homes where they find new riches. Thus, do the Egyptians procure delicious honey and plenty of wax. The proprietors pay the boatmen on their return, according to the number of the hives which they have taken from one end of Egypt to the other.

S. H.

ANSWER TO QUERY.

Query, No. 68, Page 367.

CONSTRUCTION OF THE HORIZONTARIUM.

To the Editor of the Mechanics' Register.

Sir,—In answer to the question in your publication, relative to the construction of the Horizontarium, my reply is, that it in no way differs from any other perspective; or that there can be no more than one description of perspective on any plane, whether the plane be perpendicular, parallel, or inclined to the horizon in any angle; for the picture is the section made by the plane cutting the pyramid of rays in their approach to the *vertex*, which vertex is the point of sight.

But it is useless for persons to attempt to understand the elements, except they have a thorough knowledge of geometry; without which they confound and deceive themselves, and this is too much the case in the present day.

W. Shires,
Author of the Horizontarium.
No. 7, Hayes Court,
Leicester Square.

QUERIES.

Sir,—Through becoming a Member of the London Mechanics' Institution, a fund of happiness has been opened to me, of which, but for its establishment, I should doubtless have remained in ignorance as long as I lived,—I cannot find language strong enough to express my feelings of gratitude towards those noble and disinterested individuals who, notwithstanding the opposition they have met with in their arduous task, have succeeded in placing our Institution on a firm and immoveable basis. A publication, which should faithfully record the proceedings of the Institution, was for some time a desideratum, but in your Register we have one, which so well performs that office, that there is nothing further to be wished for on that head.

As a mechanic, I have derived much instruction, as well as amusement, from the interesting illustrations of Practical Geometry, which have, from time to time, appeared in your work, and hope to see them continued. If you were now and then to insert a question requiring the application of Algebra in its solution, it would give those persons, who, like myself, have made a little progress in the elements of mathematical knowledge, an opportunity of exercising their ingenuity, and would gratify many of the Members of the Institution, and amongst the rest,

Your humble servant,
Wm. Dowling.

I send the following questions, if you think them worth inserting,—the an-answers to be worked by Algebra.

No. 72.

A labourer being hired for 12 months, was to receive for his services £24. and a cloak; at the end of 8 months he has leave to go away, and receives a cloak and £13; how much did the cloak cost?

No. 73.

Two persons, A and B, set out on a journey; A goes 6 miles a day, and 8 days after, B follows at the rate of 10 miles a day; in how many days will B overtake A?

No. 74.

A pole, 48 feet high, being broken by the wind, strikes the ground 17 feet from the root; what was the height of the fracture? W. DOWLING.

No. 75.

A GENTLEMAN has a plane triangular garden, and having inscribed the largest circular grass plot possible; the distance between the centre of the grass plot and the corners of the garden, are 12, 16 and 20 yards. What are the sides of the garden?

Walworth Road. PHILO MATH.

No. 76.

ROUND two wheels whose circumferences are as 5 to 3, two ropes are wrapped whose difference exceeds the difference of the circumferences by 280 yards. The longer rope applied to the larger wheel, wraps round it a certain number of times, greater by 12 than the smaller round the smaller wheel; and if the larger wheel turns round 3 times as quickly as the smaller wheel, the ropes will be discharged at the same time. Required the lengths of the ropes and circumference of the wheels.

CONSTANTINE.

No. 77.

THE transverse and conjugate axes of an elliptical field are 6 and 5 chains. The occupier intends to tether his horse so that it may eat the whole field, and no more, without removing the rope; query the length of the rope?

MAGIA NATURALIS.

No. 78.

A farmer has a field whose shape is a trapezium, and he is desirous of dividing it into two equal parts, by a ditch, parallel to two of its sides, which are parallel to each other; in what part must the ditch be placed when the sides of the field are 20, 21, 20 and 8 chains?

MAGIA NATURALIS.

No. 79.

AN Algebraical solution of the following question:—Having a rectangular marble slab, 58 inches by 27, I would have a square foot cut off parallel to the shorter edge; I would then have the like quantity divided from the remainder parallel to the longer side; and this alternately repeated, till there shall not be the quantity of a foot left: what will be the dimensions of the remaining piece?

H—Y P—E.

No. 80.

A Geometrical construction of the following question:—Seven men bought a grinding-stone of 60 inches diameter, each paying 1-7th part of the expense; what part of the diameter must each grind down for his share?

H—Y P—E.

NOTICE.

WE beg leave, most respectfully, to inform our numerous Subscribers, that the THIRD VOLUME of the MECHANICS' REGISTER will be completed next week, when we shall publish a Double Number, in order to include the Title Page, Preface, and Index to the Volume. The Number will be embellished with a correct likeness of SIR HUMPHRY DAVY, and will contain a Memoir of the Life of that eminent Chemist, as a suitable accompaniment to a Volume, of which a considerable portion is devoted to an illustration of the important science of CHEMISTRY.

TO CORRESPONDENTS.

The kind offer of JUVENIS has been anticipated by the intelligent Correspondent to whom he has alluded.

We are obliged to postpone till next week the insertion of the third Letter of FRANCIS jun. and the communication of G. H.

Communications have been received from A Constant Subscriber.—A. Bland.—L'ami des Sciences.—A. B. C.—T. H—h—Y. Z. &c.

From the length and importance of Mr. Wallis's Lecture, and the pressure of other matter, we must intrude on the patience of some of our Correspondents till the commencement of the Fourth Volume.

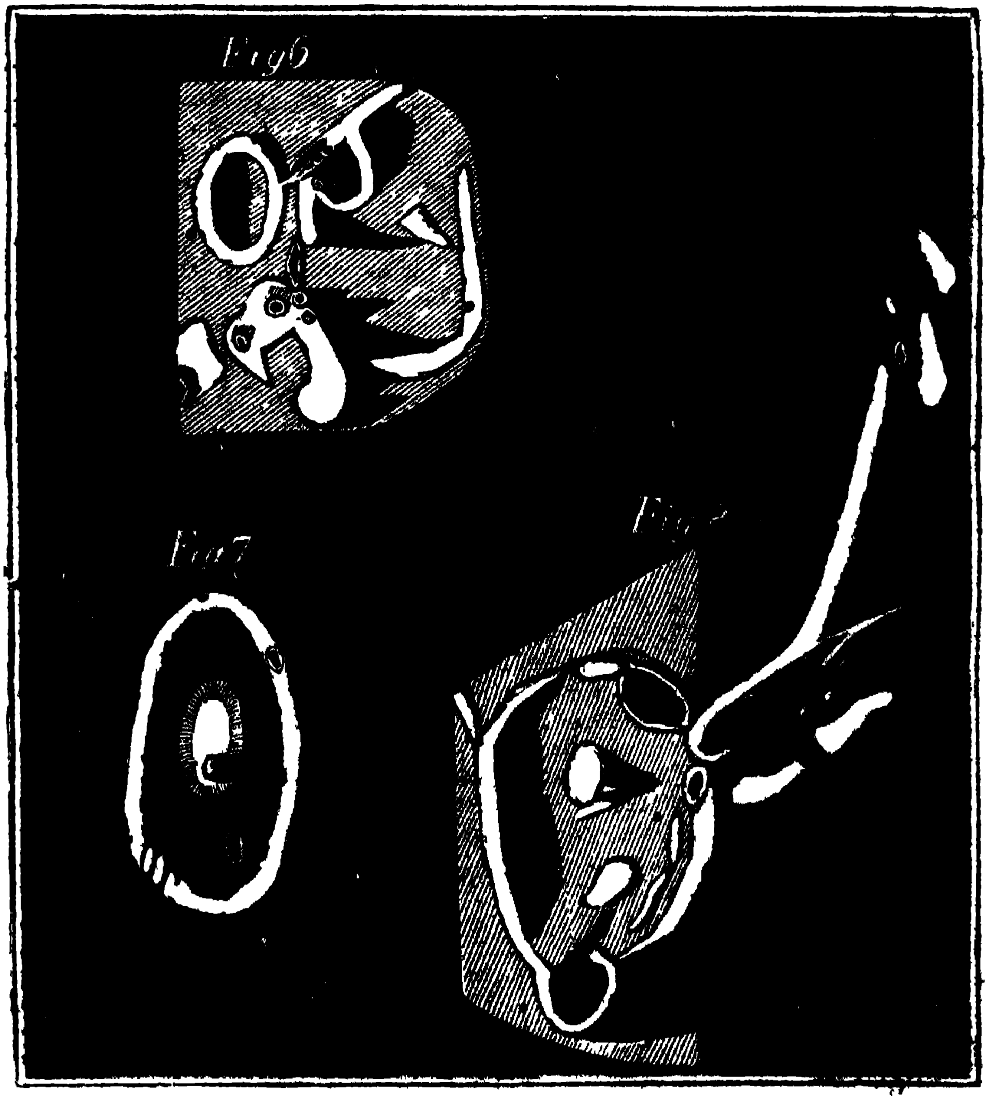
THE LONDON
MECHANICS' REGISTER.

"Has the GREAT SOVEREIGN sent ten thousand worlds
To tell us HE resides above them all,
In glory's unapproachable recess?
And dare earth's bold inhabitants deny
The sumptuous, the magnific embassy
A moment's audience?—
Who sees, but is confounded, or convinced?
Renounces reason, or a GOD adores?"

YOUNG.

No 83.] SATURDAY, APRIL 22, 1826. [Price 3d.

VIEW OF THREE REMARKABLE PORTIONS OF THE MOON'S SURFACE.



LONDON MECHANICS' INSTITUTION.

MR. WALLIS'S SECOND LECTURE ON ASTRONOMY.

DIVISION OF TIME—SOLAR AND SIDEREAL TIME—EQUATION OF TIME—REFORMATION OF THE CALENDAR—PHENOMENA OF THE MOON—HER HORIZONTAL PARALLAX—MODE OF ASCERTAINING HER MAGNITUDE — OBLIQUITY OF THE MOON'S ORBIT—HER LIBRATION—APPEARANCE OF THE EARTH FROM THE MOON—PHASES OF THE MOON —HER NODES — LUNAR AND SOLAR ECLIPSES, &c.

WEDNESDAY, APRIL 12, AND FRIDAY, APRIL 14.

Mr. WALLIS commenced by adverting to the subjects illustrated in his first lecture, in which he had considered the most striking phenomena of the *earth*, and explained the principles which led to the conclusion, that it is a *planetary* body—that its form is spherical, or nearly so—that it revolves on its axis once in every 24 hours—and that it also describes an orbit about the sun in the space of a year. Now, it is from the *diurnal* and *annual* motions of the earth, that we form our estimate of the *division of time* into specific periods. Time is the idea we conceive of the lapse of duration between any two events, but in order to have a distinct comprehension of its regular and unvarying progress, *time* must necessarily be measured by *motion;* and as we are acquainted with only one motion in nature that is *perfectly equable*, it is to this motion that we refer as the real standard of time.

The motion here alluded to is that of the earth on its axis, which is perfectly uniform and invariable, while its motion in its orbit is unequal; the velocity with which it moves being different in different parts of its annual revolution. Time is, however, also measured by that apparent motion of the sun among the stars, which results from the real annual motion of the earth in its orbit, and which is completed in about 365 days and six hours. When time is measured by the stars it is called *sidereal* time, and when measured by the sun, *solar* time; and the difference between these two methods of computing time, arises from the stars being fixed, and from their immense distance, constantly preserving the same situations relative to the earth, while the sun appears to change its place, in consequence of the earth's revolution in its orbit being performed in the same direction as its diurnal rotation on its axis. A day measured by a fixed star will, therefore, differ from a day measured by the sun; and the effect of this difference is, that while the earth revolves 366 times on its axis, with respect to the star, it will only have revolved 365 times with reference to the sun; the length of a solar day exceeding that of a sidereal day by 3 minutes and 56 seconds, which amounts to one diurnal revolution in the course of a year.

But as the computation of time by the stars would be extremely inconvenient, for this obvious reason, that they are invisible in the day-time, except by the aid of very superior optical instruments, it has been found necessary to adopt the solar division of time; and hence have arisen considerable difficulties in adjusting the inequalities resulting from the difference between solar and sidereal time, and also from the irregular, or rather unequal motion of the earth in its orbit. The adjustment of these variations is called the *equation of time*.

The earth moves round the sun in an *elliptical* orbit, and the sun is not situated in the centre, but in one of the *foci* of the ellipsis. From this cause, the distance of the earth from the sun is not always the same; for it is found that the earth is three millions of miles nearer the sun on the 7th of January than on the 7th of July; that part of its orbit which is nearest the sun being called its *perihelion*, and the opposite, or most distant part, its *aphelion;* but as the mean distance of the earth from the sun is 95 millions of miles, the difference between the distances of its perihelion and aphelion from the centre of the ellipsis is not quite one-thirtieth part of its semi-diameter.

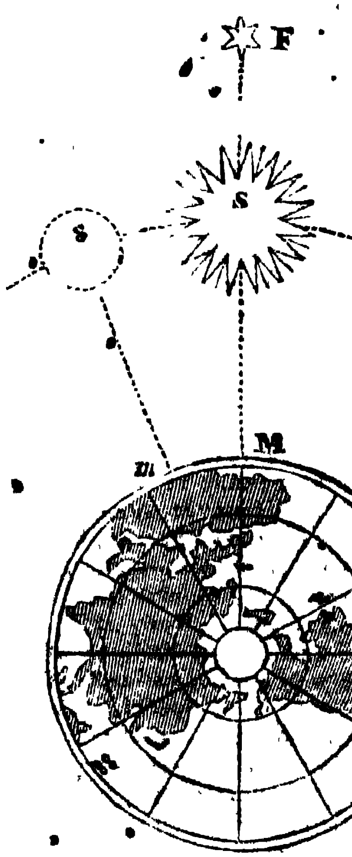
Now it follows, from the perfection of the laws of gravitation, that as the earth revolves in an elliptical orbit, it must necessarily move quicker in one part of its revolution than in another; and as the apparent revolution of the sun does not take place in the equator, but in the *ecliptic*, these two causes, viz. the unequal revolution of the earth in its orbit, and the oblique direction in which that unequal revolution is performed, combine to produce a difference in the length of our days, and to occasion difficulties in the correct computation of time.

Another cause of difficulty is, that the earth does not complete its annual revolution in any equal number of days, but occupies about 365¼ days in passing through its orbit. This difficulty would be diminished, if the period were exactly 365¼ days; for in that case, we need only add 4 of the odd quarters together, and make every fourth year consist of 366 days, to reconcile the diurnal with the annual revolution of the earth. But we should then exceed the real time, because the period of the earth's annual revolution, or the actual length of a year, is only 365 days, 5 hours and 49 minutes. The difference arising from this cause is adjusted in the following manner:—

The method adopted by the astronomers under the reign of Julius Cæsar, of adding one day to every fourth year, having, in the course of several centuries considerably exceeded the true time, and it being a matter of great importance in the Papal Church, that their feasts and fasts should be regulated according to the true periods of their occurrence, a reformation of the calendar took place under Pope Gregory XIII., when it was determined to omit three leap-years in the course of every five centuries. By this means, the difference between real time and its computation by the Gregorian calendar, is so small that it amounts only to 2 hours and 16 minutes in 500 years. This trifling difference may be allowed to accumulate till it amounts to a whole day, when it may again be adjusted by omitting a leap-year. The Protestants, however, would not follow the example of the Catholics, even when they were in the right, and a long period elapsed before the Gregorian calendar was adopted in this country. This alteration at length took place at the commencement of the New Style, by which time the difference amounted to 11 days, which were omitted in the month of September, 1752; and it will be recollected by the audience that the year 1800, which would otherwise have been a leap-year, was passed over without the additional day in February. This was because it was one of the three leap-years directed to be omitted in the course of five centuries, as we have already stated. The leap-year was called Bissextile, because in the Julian calendar, the sixth of the calends of March was reckoned twice over in every fourth year.*

Mr. Wallis now exhibited a very beautiful transparency, for the purpose of explaining more distinctly the cause of the difference between *solar* and *sidereal* time.

Fig. 9.



This transparency, which we have endeavoured to represent in the above diagram (Fig. 9.), exhibited the earth, on a north polar projection, revolving round its axis, while the sun was moving in its apparent orbit round the earth. The Lecturer first directed the attention of the audience to the relative situation of the earth, the sun, S, and the fixed star, F, as represented in the figure; the sun and the star being both in the meridian of a spectator at M. The earth then revolved slowly on its axis till it had made exactly one revolution, when the fixed star, F, was again on the meridian of the spectator; but, by this time, the sun, proceeding eastwards on its orbit, or in the same direction as that in which the earth revolved, had advanced as far as *s*; and it was, therefore, clearly seen, that before the sun could be in the meridian of the observer, the earth must revolve till he reached the point *m*. A *sidereal day* is, therefore, the exact time in which the earth revolves once on its axis, but it must evidently make rather more than one revolution before a *solar day*, which is the period we divide into 24 hours, can be completed. The difference between *sidereal* and *solar* time is exaggerated in the diagram, to make the illustration more intelligible, but it amounts, as before observed, to 3 minutes and 56 seconds per day, or about one day in every year.

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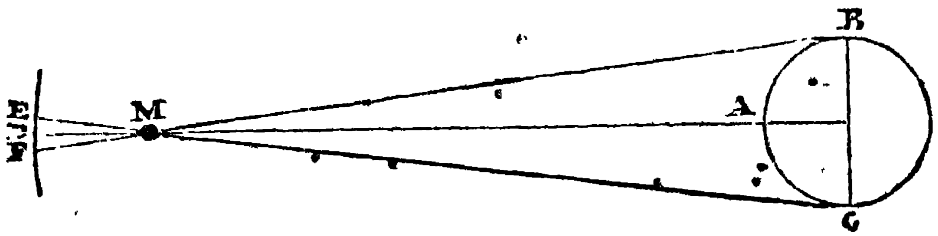
* *Bis sextas* calendas Martii.

The oblique motion of the sun in the ecliptic, instead of the equator, has been mentioned as another source of inequality in the computation of time; and the effect of this is, that, except at four points of the earth's orbit, where *real* and *apparent* time are alike, the real time and the time indicated by the sun will differ, and the former will be either faster or slower than the latter. To adjust this difference, the time is regulated by an imaginary sun, which is supposed to move in the equator.

Mr. WALLIS next proceeded to illustrate the phenomena of the *Moon*, which is another very important body in nature, and is called a secondary planet, because it revolves round another planet, the earth, as its primary. The moon is a comparatively small body, though it appears about as large as the sun; but its distance is only one four-hundredth part as great. The method of determining the relative magnitudes of the earth and moon, by finding the *horizontal parallax* of the latter, and thence deducing its actual magnitude, may be pointed out in a very familiar manner. If, continued the Lecturer, I look at one of the lamps in the Theatre from the situation in which I stand at the present moment, the lamp is referred to a particular spot on the wall, but when I remove to another situation, the lamp appears on another part of the wall. Now, if two lines are supposed to pass through the lamp from my eye, in both these situations, they will form a certain angle, which will be the *parallactic angle* of the lamp. Applying this principle to the moon, the method of ascertaining her *horizontal parallax* will be clearly understood by the following diagram:—

Fig. 10.



To a spectator at A, the moon, M, will appear in the heavens in his *zenith* at D, but it will be, at the same time, in the *horizon* of an observer at B, who will therefore see it at F, while, to another observer, at C, it will appear at the point, E. The angle, E M D, which is found to be 57′ 18″, is, therefore, the *horizontal parallax* of the moon; and as this angle is equal to the angle B M A, subtended from the moon by the semi-diameter of the earth, it is evident, that double this angle, or the angle B M C, is the angle under which the earth would be seen by a spectator at the moon. Knowing this, and also the exact angle subtended by the moon's apparent diameter, as seen from the earth, which is 31′ 02″, it is very easy to ascertain the *relative* magnitudes of the two bodies, by reducing the angles into seconds, and dividing double the moon's horizontal parallax by the seconds contained in the angle subtended by the moon's apparent diameter.

The magnitude of the moon, compared with that of the earth, will be thus ascertained to be as 1 to 3.69; and as we know that the diameter of the earth is 7912 miles, the *real* magnitude of the moon may be found by a similar operation in the rule of proportion; for, as 3.69 is to 1, so is 7912 (the diameter of the earth) to 2144, the *real diameter* of the moon in miles. The following are the details of the first part of the operation.—

57′ 18″ } Moon's Hor. Parallax.
60
——
3438
.2
——
6876 { Earth's apparent Diameter at the Moon.
——

31′ 2″ } Moon's apparent Diameter.
60
——
1862
——

1862) 6876 (3.69
5586
——
12900
11172
——
17280
16758
——
522
——

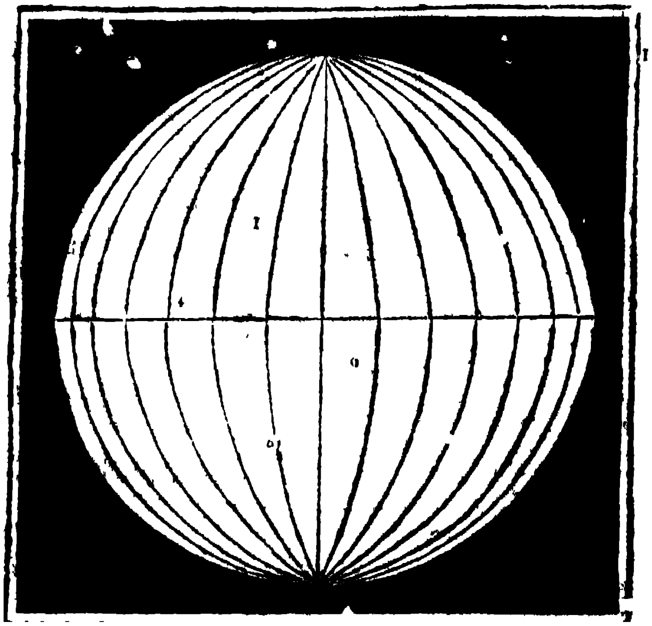
If we wish to know how much the *surface* of the earth exceeds that of the moon, it is ascertained by comparing the *squares* of their diameters; and their respective *bulks*, as compared with each other, may be found by the proportion existing between the *cubes* of their diameters. By this means it will be found, that the *surface* of the earth is to that of the moon, as $13\frac{1}{2}$ is to 1, and its bulk or size is as $50\frac{1}{4}$ to 1. If, therefore, we suppose that the earth is as capable of reflecting light as the moon, it will appear, that the former will reflect $13\frac{1}{2}$ times as much light to the moon, as the latter reflects to the earth. It may, in fact, be considered, that the earth is a moon to the moon, the former *being* at the *full* when the latter is *new*, and *vice versa*

It may, at first sight, appear improbable, that the earth should reflect light as the moon does; but if we compare the moon, as seen in the day-time, with a cloud strongly illuminated by the rays of the sun, we shall find, that the light reflected from the cloud is more vivid than that of the moon, and that, when the moon is rising by day-light, it does not appear brighter than a distant house, from which the beams of the sun are reflected to the eye. There is not, in reality, any sufficient reason for believing that the earth is not as well adapted as the moon for reflecting light, and if this be admitted, it will follow, that the moon receives from the earth $13\frac{1}{2}$ times as much light as she imparts to it. This is confirmed by the appearance of the new moon, the whole disc of which is distinctly visible, and some of its most brilliant spots can be seen with the telescope, though no part of its illuminated surface is turned towards the earth. If, at this time, no light were reflected from the moon, it would be completely invisible. It must, therefore, be seen in consequence of the quantity of light reflected from the earth to the moon, and thence reflected back to the earth.

But it is only to the inhabitants of one half of the moon that the earth is ever visible, because, as she makes one revolution on her axis in the exact time which she occupies in going once round the earth, the same hemisphere is constantly turned towards her primary planet. A slight deviation from this general remark occurs in consequence of the elliptical form of the moon's orbit, from which it results, according to the universal principle of gravitation, that her motion in her orbit round the earth is quicker in one part than in another, while her rotation on her axis is perfectly equable. From this cause, an oscillation appears to take place on the eastern and western limbs of the moon, which alternately brings a small additional portion of its surface within *our view* on each edge, and this oscillation is called the moon's *libration in longitude*. The longer diameter of the moon's orbit is to the shorter as 32 to 28; its most distant point being called her *apogee*, and the nearest her *perigee*. When at or near the former point, she moves through only 11° in a day, while, on approaching the latter, her velocity is increased to 14° in the same time. The earth, as seen from the moon, must present a singular appearance; for while the stars seem to be revolving round it, the earth will be seen turning on its axis, but constantly occupying the same place in the heavens. To those inhabitants who are situated in the centre of the lunar hemisphere which is turned towards us, the earth will constantly appear directly over-head; while to those who live on each side, the earth will appear in the horizon, or will seem to be a little above or below it, owing to the moon's libration.

The globular form of the moon is satisfactorily proved by the apparently unequal motion of the *terminator*, or boundary of light and darkness, across its surface, during its progressive changes from *new* to *full*, and *vice versa*. This will be obvious by an inspection of the following diagram (fig. 11.), which was exhibited by Mr. WALLIS to illustrate his remark:—

Fig. 11.

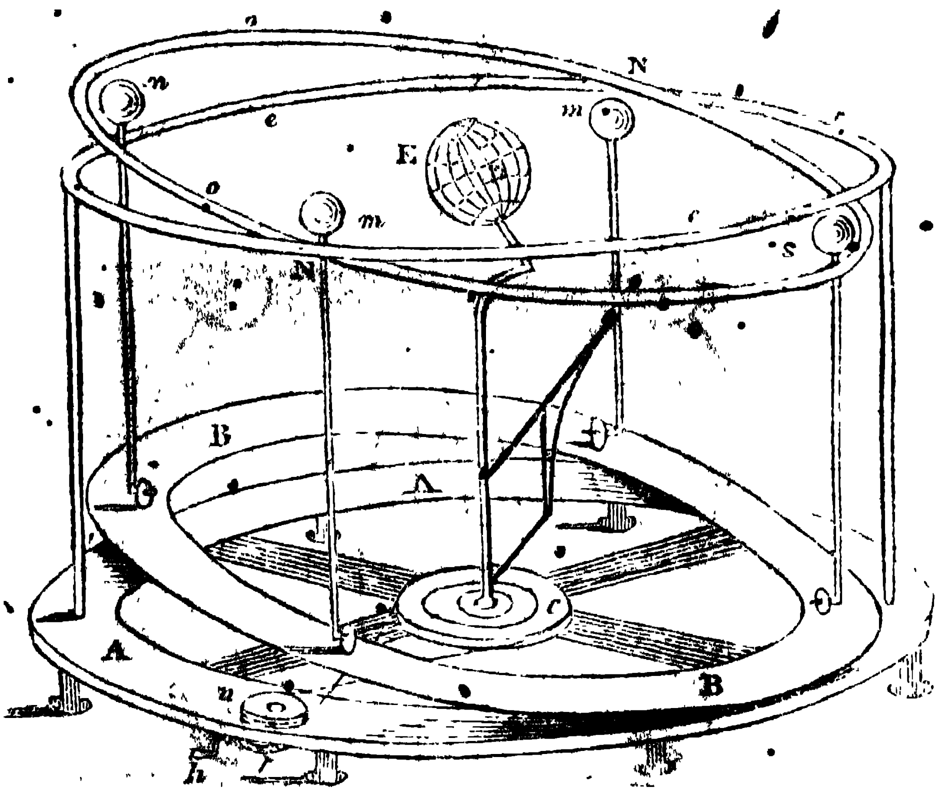


This figure represents a globe, of which, half the surface is divided into 14 equal parts; but as the divisions near the edges are seen in perspective, they will be *fore-shortened*, and will, therefore, appear much smaller than those near the centre. Now, as the motion of the moon's terminator is nearly *equable*, it will occupy the same time in passing over each of these divisions; but as the divisions near the sides appear much smaller to the eye than the central divisions, it follows, that the motion of the terminator will seem much more rapid towards the centre than near the eastern and western limbs of the moon; and this is its actual appearance in nature.

Mr. WALLIS further elucidated this subject by exhibiting a globe, of which one half was painted black, and the other white. This globe was made to turn upon its axis, with an *equable* motion, in a black frame, so that only one half of it was visible to the spectators. The white side, representing the full moon, was first exhibited, and as the globe revolved slowly and equably on its axis, all the various phases of the moon were successively displayed, and the inequality in the apparent motion of the terminator was distinctly perceivable.

The Lecturer then proceeded to explain the important phenomena of *lunar* and *solar eclipses*, which occur whenever the earth, the moon and the sun are on a straight line with each other. When the earth is between the sun and moon, the latter becomes eclipsed by passing through the earth's shadow; and when the moon is between the sun and earth, the sun is eclipsed by the moon's passing over its surface. A *lunar* eclipse, therefore, can only occur when the moon is at the *full*, or in *opposition* to the sun, and a *solar* eclipse when she is *new*, or in *conjunction* with the sun. Now, if the orbit described by the moon round the earth coincided exactly with the plane of the ecliptic, there would be an eclipse of the moon and another of the sun every month, but this effect is prevented by the *obliquity* or *inclination* of the moon's orbit to the ecliptic. To illustrate this observation, Mr. WALLIS introduced the ingenious piece of mechanism represented in the following engraving (fig. 12):—

Fig. 12.

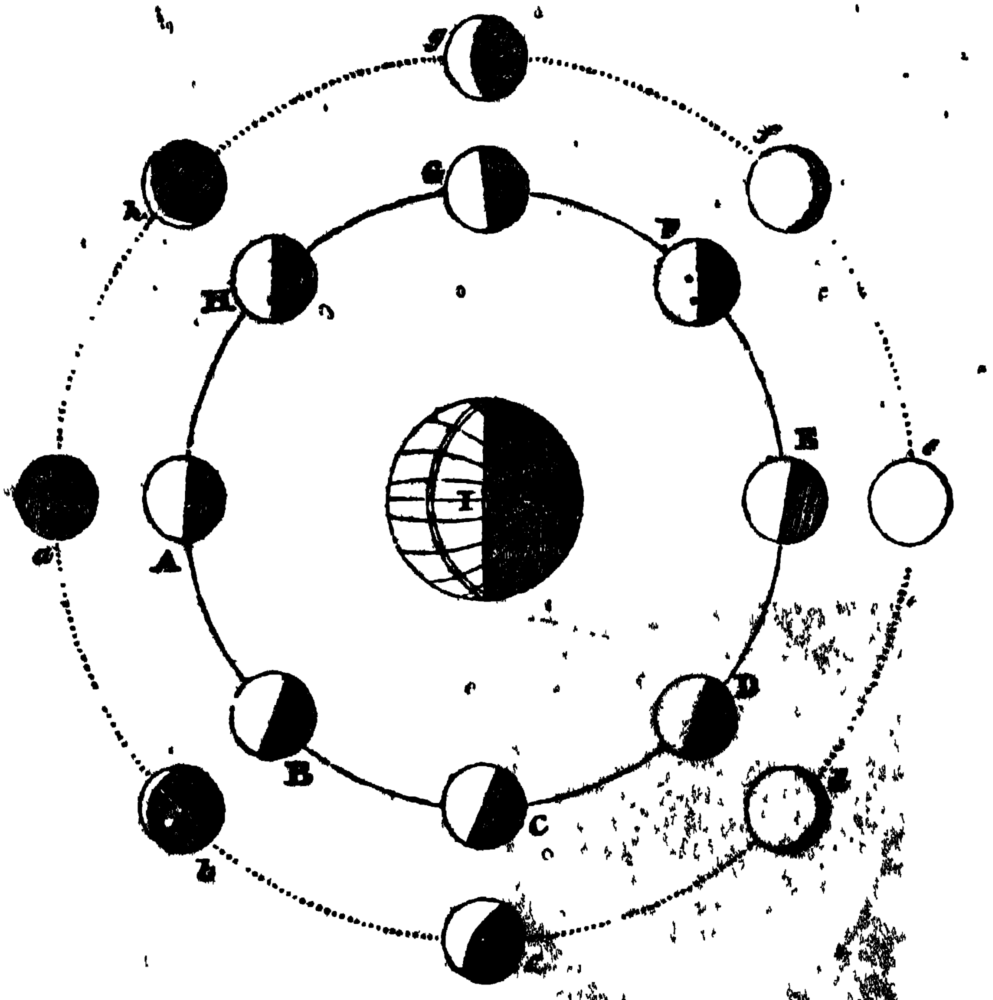


In this apparatus, the frame, A A, supports the horizontal hoop, *e e e*, which represents the *ecliptic;* within which is placed the hoop, *o o o*, in an inclined position, representing the orbit which the moon describes round the earth, E, and intersecting the ecliptic at the opposite points, N N, which are called the *nodes* of the moon. The small globe, representing the moon, is supported by a rod, connected with a little wheel which runs on the inclined plane, B B, parallel to the moon's orbit; and the machine is put in motion by turning the handle, *h*. This handle turns an endless screw, working in a toothed wheel, *t*, the spindle of which turns the small wheel, *w*, connected by an endless cord with the central wheel, *c*. The revolution of this wheel carries round the artificial moon in the direction of the oblique hoop, *o o o*, and affords an excellent imitation of the moon's revolution in her orbit.

If the moon moved in the ecliptic or horizontal circle, *e e e*, her motion would be in the same plane with the apparent motion of the sun; and as the sun and moon would be in *conjunction* and in *opposition* in the course of every revolution of the latter in her orbit, they would be alternately eclipsed at every new and full moon. But eclipses can only happen when the moon is in or near the *nodes*, or the two opposite points where her orbit intersects the ecliptic, as at *m m*, in the diagram, fig. 12; for when she has proceeded in her orbit from *m* to *n*, she is rather more than 5° above the ecliptic, and is said to have *north latitude;* and when she reaches the opposite, or lowest point of her orbit at *s*, she is as much below the ecliptic, and possesses south latitude. In either of these situations she cannot be in a line with the earth and sun; and as the *nodes*, or points of intersection, N N, are constantly shifting their places, and travelling *backwards* in the ecliptic, round which they move in about 19 years, it is obvious that eclipses cannot happen in the course of every revolution of the moon in her orbit, for they can only occur when the moon is new or at the full, at or near the time when she is in one of the *nodes*, or moveable points where her orbit crosses the *ecliptic*.

Mr. Wallis then prepared some beautiful transparent diagrams, to afford a further illustration of some of the phenomena to which he had adverted. The first of these transparencies exhibited the various phases of the moon, as shewn in the following diagram, fig. 13:—

Fig. 13.

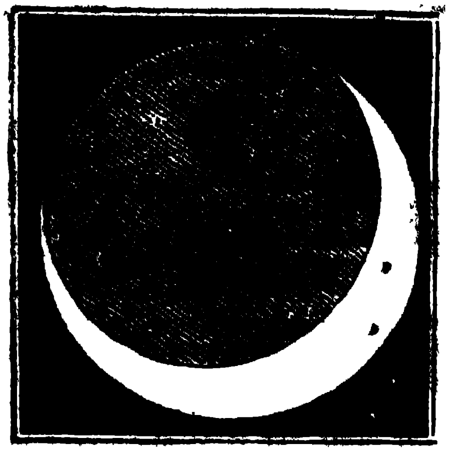


In this figure, the sun is supposed to be situated at an immense distance on the *left* of the spectator, and to illuminate the moon in eight different parts of her orbit. When the moon is at A, she is in *conjunction* with the sun, and the whole of her dark side being turned towards the earth at I, she appears *new*, as at *a*. When she has described one-eighth of her orbit, as at B, a portion of her enlightened surface is turned towards the earth, and she is seen in the form of a *crescent*, as at *b*. At C, she has completed her first quarter, and assumes the form of a *half-moon*, as at *c*. On arriving at D, a still larger portion of her enlightened hemisphere is turned towards the earth, and she now appears of an *oval* or *gibbous* form, as at *d*; and when she has proceeded as far as E, she has completed half her orbit, and being now in *opposition* to the sun, the whole of her enlightened side becomes visible, and she is at the full, as at *e*. Passing through the remaining half of her orbit, the same phenomena occur, but their order is reversed, and we progressively lose sight of her enlightened hemisphere as she passes through F, G, and H, till the period of the new moon again occurs, on her arrival at A. The planets, *Venus* and *Mercury*, present the same phenomena to our view, and exhibit, during their revolution round the sun, all the various *phases* displayed by the moon.

The next transparency exhibited the earth revolving on its axis and in its orbit, while the moon performed her revolution round the earth. This diagram afforded a distinct illustration of the fact, that the moon constantly presents the same hemisphere to the earth, because she revolves once on her axis, in precisely the same time which she occupies in completing her revolution in her orbit. The machinery was, in the first place, so adjusted that the moon proceeded round the earth *without revolving on her axis*, and it was clearly seen that, by this arrangement, every part of her surface was successively visible from the earth. But when, by a slight alteration in the ingenious mechanism of the apparatus, she was made to revolve once on her own axis, while she went once round the earth, the same part of her surface was invariably turned towards the latter, and her real appearance in nature was strikingly exemplified.

Some smaller transparencies were then exhibited, one of which represented the moon as at fig. 14, with only a small portion of her enlightened surface turned towards the earth, while the rest of her hemisphere is faintly visible by the light reflected from the earth's surface: this appearance has been called "the old moon lying in the new moon's arms:"—

Fig. 14.



It has been already observed that the phases of the earth and moon *alternate* with each other." When the moon, therefore, assumes the form of a *crescent*, as in the above figure, the earth will appear *gibbous*, or nearly *new* to the moon, and will reflect a sufficient quantity of light to render the dark part of the moon visible. In this situation, the exterior edge of the crescent appears to form part of a *larger circle* than the unenlightened portion; but this is an optical deception, arising partly from the extreme brightness of the crescent, and partly from its great distance, owing to which, it is not exactly adapted to the naked eye; for when a good telescope is used, this apparent discrepancy ceases.

Two other illuminated diagrams were then exhibited, one of them representing the telescopic appearance of the moon when about three days old; and the other, the irregularity of the moon's edge, as seen on the sun during the great eclipse of 1820.

The frontispiece to the present Number is a correct representation of the splendid transparency next exhibited by Mr. Wallis, which displayed three remarkably brilliant portions of the moon's diversified surface, as seen through telescopes of high magnifying powers. These spots are respectively called *Aristarchus* (fig. 6), *Ptolemy* (fig. 7), and *Gassendi* (fig. 8); the first of the three being the brightest part of the moon's disc.

In the next transparency, a brilliant sun was seen turning on its axis, while the earth passed through a portion of its orbit, and the moon revolved round the earth with her enlightened hemisphere constantly directed towards the sun. This transparency correctly exhibited the relative *velocities* of the earth and moon, though their respective distances from each other and from the sun were necessarily incorrect, as the circumscribed dimensions of the area of the diagram would not allow the Lecturer to imitate nature in this particular. To effect this, it would be necessary to place the earth 400 times as distant from the sun as the moon is from the earth, in which case it would be seen, that the moon's orbit, which in this transparency appears sometimes *convex* towards the sun, is in reality always *concave* towards that luminary.

The remaining transparencies consisted of correct and beautiful representations of *lunar* and *solar eclipses*, as they occur in nature. A partial *lunar eclipse* was first exhibited, and the shadow of the earth was seen touching the *Eastern* limb of the moon, on which side *lunar* eclipses always begin, and slowly obscuring a considerable portion of its surface till it passed off on the opposite, or *Western* side. It is observable, that the portion of the earth's shadow, as seen on the moon during an eclipse, always forms part of a circle, much *larger* than the moon herself; and as the diameter of the conical shadow, at the distance of 240,000 miles from the earth, must be much smaller than that of the earth by which it is projected, this circumstance affords a strong proof that the earth greatly exceeds the moon in magnitude.

A *central* and *total* eclipse of the moon was next exhibited, which occurs when she is exactly in the *node*, at the time of the full moon. A *lunar* eclipse may be *total* without being *central*, but a *central* eclipse must necessarily be total. Under favourable circumstances, an eclipse of the moon may last four hours, and her disc is faintly visible while she remains enveloped in the earth's shadow.

In the representation of a *solar eclipse*, the new moon was seen slowly encroaching on the *Western* limb of the sun, where the beginning of the *solar* eclipses always occurs, and gradually passing over a portion of his disc, till she disappeared on the *Eastern* side. The greatest number of eclipses that can happen in one year is seven, and the smallest two, which will both be *solar*.

Mr. Wallis finally exhibited that beautiful phenomenon of nature, an *annular eclipse* of the sun. This was supposed to happen about the 7th of January, when the sun is at its least distance from the earth, at the same time that the moon is in her *apogee*, or at its greatest distance from the earth. The diameter of the sun then subtends its *greatest*, and that of the moon its *least* possible angle, in consequence of which the shadow of the moon does not extend quite so far as the earth's surface, but terminates at some distance above it. The moon, under these circumstances, covers the whole disc of the sun, with the exception of a brilliant *annulus* of light, which completely encircles it. This beautiful appearance was faithfully represented by the transparency, and the Lecturer observed that the great solar eclipse which occurred in the year 1820, was *annular* in higher latitudes than our own. In total eclipses of the sun, its complete obscuration can never last longer than about 8 minutes.

Mr. Wallis here observed, that he had one or two remarks to make, which he trusted the Members would excuse, though the subject related personally to himself, rather than to his audience. Since delivering his first lecture, he had received a letter from an individual, whose name it was unnecessary to mention, in which the writer expressed himself offended and disgusted, because he had introduced a moral reflection, in illustrating the great principle upon which depends the motion of the smallest body, as well as that of the vast and magnificent planet, Saturn. "But," continued Mr. Wallis, "I have a right to consider that you have *moral* as well as *intellectual* minds, and that the contemplation of the sublime truths of Astronomy must lead you to the conclusion, that there exists an all-wise and all-powerful Being, by whom the wonderful operations of Nature are directed. If a skilful workman should produce an excellent piece of mechanism, would you not bestow upon him the meed of praise for his ingenuity? Is it then out of place; when developing those great principles which human skill cannot even imitate, to express a feeling of admiration for that magnificent system of Nature which enlarges the mind, and frees it from the trammels of Atheism? I quoted the words of an ancient poet, who observes, that 'it is the fool which hath said in his heart, there is no God;' for surely it is contrary to common sense to deny his existence. Conceiving that, as your Lecturer, I have not only an intellectual but a moral duty to perform, I have thought it necessary to make these remarks, because, in the course of my remaining lectures, I may again feel myself compelled to introduce remarks, similar to those which occasion the animadversions contained in the letter I have received."

The universal and reiterated applause with which this address was received, must have convinced Mr. Wallis that, whatever may be the sentiments of a few individuals in the Society, the great body of the Members perfectly coincide with his views, and as they progressively advance in the paths of science, discover at every step additional motives for admiring the wisdom of the Great Creator of the Universe.

LECTURES FOR NEXT WEEK.

Wednesday, April 26th, Mr. Wallis's Fourth Lecture on Astronomy.

Friday, April 28th, the same Lecture repeated.

VOLCANO IN THE MOON.

To the Editor of the Mechanics' Register.

Sir,—If you think the following notice, respecting a volcanic appearance in the moon (as published by Captain Henry Kater, F.R.S.), worth insertion in the Mechanics' Register, it is at your service.

Yours, &c.
A. Bland.

"On Sunday evening, the 4th February, I observed a luminous spot in the dark part of the moon, which I was inclined to ascribe to the eruption of a volcano.

"The telescope used was an excellent Newtonian, of 6¼ inches aperture, with a power of 74. The moon was exactly two days old, and the evening so clear that I was was able to discern the general outlines in the dark part of her disc. Her Western azimuth was about 70°, and her altitude about 10 degrees. In this position, at 6 hours and 30 minutes, the volcano (estimating by the eye) appeared distant from the Northern limb of the moon about one-tenth of her diameter. Its appearance was that of a small *nebula*, subtending an angle of about three or four seconds. Its brightness very variable; a luminous point, like a small star of the sixth or seventh magnitude, would suddenly appear in its centre, and as suddenly disappear, and these changes would sometimes take place in the course of a few seconds. On the evening of the fifth, having an engagement which prevented me from observing it myself, I arranged the telescope for two friends, who remarked the same phenomena as the night before, but in an inferior degree, partly, perhaps, in consequence of the evening not being so favourable. On the 6th, I again observed it; it had certainly become more faint, and the star-like appearance less frequent. I could see it very distinctly with a power of 40: as the moon approached the horizon, it was visible only at intervals, when the star-like appearance took place. On the same evening, I had the pleasure of shewing it to Mr. Henry Browne, F.R.S. I regret that I had no micrometer adapted to my telescope, but I have reason to believe the distance of the volcano from the edge of the moon was about one-tenth of her diameter; and the angle it formed this evening with the line joining the cusps, was about 50°. I remarked near the edge of the moon, a well-known dark spot, from which the volcano was distant, as nearly as I could estimate, three times its distance from the edge of the moon. In a map of the moon, published by Dr. Kitchener (and which is the best small map with which I am acquainted), there is a mountain sufficiently near the situation of the volcano, to authorise the supposition that they may be identical. On the 7th, I could still see the volcano, and the occasional star-like appearance, but I do not think it was sufficiently perceptible to have been discovered by a person ignorant of its precise situation. I am inclined, however, to think that the difficulty of seeing it, is rather to be attributed to the increased light of the moon, than to the diminished action of the volcano. The spot in which I observed the volcanic appearance is that named *Aristarchus*. This spot was particularly examined by Hevelius, who calls it *Mons Porphirites*, and who considers it to be volcanic. If his drawings are to be relied upon, it has undergone a considerable change in its appearance since his time. Sir William Herschell has recorded in his Philosophical Transactions, an observation of three volcanoes which he perceived in the moon,[*] April 19th, 1787, at $10^h\ 36^m$, sidereal time. One of these, which he said showed "an actual eruption of fire or luminous matter," was distant from the Northern limb of the moon $3'\ 57''.3$, the diameter of the burning part being not less than $3''$. I find that this observation was made about 9 o'clock in the evening, when the moon was not quite two days old; and from the situation of the spot described by Sir William Herschell, I have no doubt of its being the same that I have noticed."

UTILITY OF BOTANICAL STUDIES.

[Concluded from page 396.]

To the Editor of the Mechanics' Register.

SIR—Having, in my former lettter, drawn the attention of your readers to the simplest method of distinguishing plants from each other, at least as far as relates to the first eleven classes, I will therefore not detain them much longer upon this part of the subject; especially as the means of discrimination to be observed in the latter classes, are, if not exactly the same, at least very similar.

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[*] See Mechanics' Register, Vol. III., page 28.

The *gaping* flowers of the 14th class—the *four* petalled and cruciform appearance of those of the 15th—the butterfly-shaped petals of the 17th, and the compound flowers which belong wholly to the 19th, are so easily distinguished, by their form alone, from other plants, that a particular description of them is unnecessary. The elucidation of the other classes is rather more difficult; but most of the plants belonging to them are well known, as *geraniums, mallows, St. John's wort, oak, cucumber, poplar tree, the hop,* &c. &c. and those which are less known contain so many peculiarities of structure, singularity of form, and curious properties, as amply to repay the young botanist for the little extra time and trouble which he may devote to their development. The *species* of the 24th class are, however, still more difficult to investigate; but here it is only sufficient for the student to divide these plants into their four natural orders of *ferns, mosses, sea-weeds,* and *fungi, or mushrooms,* leaving the *specific* and *generic* distinctions till practice has made the easier parts of the science familiar to him.

I have now concluded the former part of my subject, viz. the method of distinguishing plants from each other, and ample entertainment and instruction would accrue to the student, even were he to proceed no farther in the study of Botany: but how much will his delight be increased and his curiosity excited, upon consideration of the remarkable vegetable productions of foreign climes, and reflection upon the many wonderful contrivances of nature in their propagation, food, and means of defence; upon the sleep of plants, regular time of awaking, the circulation of the sap, on the absorption and evaporation of fluids, various secretions, the resinous or thorny nature of their coverings, so admirably adapted to defend them against the attacks of frost or the depredation of various living enemies:—but I shall not expatiate upon these many interesting particulars, but refer your readers, as TYRO has done, to the able lectures of Mr. Wheeler upon the subject, and to Keith's Physiological Botany, in 2 vols. where they will find them, as well as many other curious particulars, ably and satisfactorily explained and particularized.

I cannot help, however, adverting in a few words to the variegated mixture of colours which adds so much to the beauty of many of our cultivated plants. *Wild* flowers are for the most part of *one whole colour*, or when they mingle together, it is in a regular and gradual manner, like the colours in the rainbow, not as in the abrupt and irregular streaks so observable in the *tulip, carnation,* &c. nor as in the varied spots seen on the leaves of the *japonica, holly,* &c. This beautiful appearance is generally occasioned by the want of sufficient nourishment, thus producing a sort of disease in the plant which no after cultivation can remedy. Florists are accustomed to plant their seedling tulips, which are naturally of one colour, in rubbish until their colours are divided into the delicate white or vivid yellow of the ground colour, and the dark stripes which add so much to the beauty and nominal value of the flower. All spotted or streaked flowers have not, however, become so from this cause; many instances may be found of flowers which are naturally party-coloured or spotted, presenting an appearance equally beautiful, as various species of the *lily, fritillary, London pride,* and many others.

But I must now proceed to a more important part of the subject—the gathering and preserving specimens. All plants which are to be preserved must be gathered when perfectly dry and free from every kind of *external* moisture, or they will very soon lose their colours and become mouldy. From the impossibility of finding the water and sea plants in this dry state, and from their afterwards rapidly imbibing moisture, they are rather difficult to keep from mouldiness or mildew—the great evil to be guarded against in the preservation of dried specimens.

Besides dryness, another circumstance is to be observed in the collection of plants, to gather such only as contain all the characterestic parts. Each specimen ought to have not only the flowers in perfection, but leaves, stem, seed vessel, tendrils, if any, and roots as often as they can be preserved. As soon after these plants are gathered as may be convenient, they must be carefully placed between the leaves of a book made of blotting paper, leaving two or three sheets between each plant: when thus placed let them be submitted to a gentle pressure, either under a weight or in a screw-press. After some hours, the blotting paper will have absorbed a great part of the moisture they naturally contain, and the plants will become withered; when they should be removed into a dry book of the same description, and suffered to remain under a similar pressure for at least a week, when they will be found for the most part dry and fit to be pasted upon white paper for preservation: those specimens which are not yet sufficiently freed from their sap and juices, may either be pressed again, or rubbed over carefully with a hot *flat iron*, which last practice is highly to be recommended: care must be taken, however, not to heat the iron so much as to burn the plant; it should not be heated above that degree which the hand can easily bear, without a sensation of pain. No other preparation is necessary—if care has been taken in the preceeding process they will retain for years their natural form and colours—with the exception of a few plants, the tints of which generally fly in a little time, as that of the *violet*, and of the *rose campion*, &c. In submitting plants to pressure they must be laid as flat as possible, in order that the pressure may be equal; it will therefore often be necessary to cut away a part of the *stalk* or *stem*, *root*, or even sometimes the under side of the flower itself. Instead of blotting paper for the *first* pressure, different folds of calico may be often used with advantage for succulent plants.

I have now completed my proposed design, and have only to apologize for the length of this letter, much longer indeed than I had anticipated. Another department of the science, your readers will find needful, which I hope some botanist better qualified than myself will communicate, that is the *habitants* of those plants which grow within 10 miles of London.

FRANCIS, jun.

55, Great Prescot-St.
Whitechapel.

Since writing the above, I have seen a little book entitled Practical Botany, by Mr. Johns, M. D., which, from a cursory view, appears well to merit the attention of the young as well as the experienced botanist.

PROPOSED MECHANICS' INSTITUTION IN THE BOROUGH OF SOUTHWARK.

We are happy to observe that preparations are in progress for establishing a Mechanics' Institution in the Borough; for which purpose a preliminary meeting will be held at the Globe, in York Street, Borough Market, on Monday next, at 7 o'clock in the evening precisely. As the meeting will be open for the admission of all persons who are favourable to the proposed measure, we hope the friends of science in this populous district will attend the meeting, and afford their advice and assistance to the gentlemen who have been instrumental in calling it.

PRISMATIC COLOURS.

To the Editor of the Mechanics' Register.

Sir—Your correspondent, H. S. (page 399) says he is, at present, engaged in an experiment where a lens of high magnifying power is used, and that the colours caused by *refraction* and *refrangibility* are so extremely vivid as to offer a formidable impediment to its success, and wishes some of your correspondents to inform him—

1st. Whether there is any method of destroying, or counteracting this *refraction* and *refrangibility* of rays in glass, where they are found to exist. 2nd. If it is possible to procure glass of any kind, as common plate glass lenses, or reflectors, in which this refraction does not occur.

The difficulty here complained of, has been long since overcome; first by Sir Isaac Newton, and more lately by Mr. Dollond. The former, by means of metallic speculums or mirrors, which answer the purpose perfectly, and admit the application of a great magnifying power; but the speculums are liable to tarnish, and great accuracy is requisite to give them the true figure; for an error in a reflecting surface, affects the direction of the rays much more than a like error in a *refractory* surface.

The invention of Mr. Dollond, consists in the application of a compound spectrum called *achromatic* or *colourless*, composed of white flint and crown glass, whose refracting angles are so calculated with respect to each other, that refraction is performed without any divergency of colour. This discovery, it is well known, has been applied to his telescope, and has acquired for him great celebrity, as well as considerable wealth. If H. S. will, therefore, take the trouble to look into Nicholson's Philosophy, Vol. 1. p. 375, or any of the works which treat of *achromatic refraction*, he will see the theory of it fully developed.

One of my inquiries (at page 269), as to the cause of the prismatic colours being found, sometimes, permanently affixed on the bars or side of a polished steel grate, I find satisfactorily explained on referring back to Mr. Partington's lecture on light, &c. at page 247, Vol. 1. of your entertaining and useful work. Mr. P. says, "the surface of a steel knife, if exposed to the heat of a spirit lamp, or a hot iron, assumes a variety of tints, which arise from the combination of portions of the steel with the *oxygen* of the atmosphere." "These colours," he says a little farther on, "may be removed by spirits of salt, but they cannot be restored without re-polishing the blade of the knife."

With respect to the beautiful prismatic colours seen on the surface of soap bubbles, I differ in opinion with Mr. D. Thomas, (page 381-2) who ascribes them to "minute atoms of *alkaline matter* projecting above the surface of the bubbles, and presenting innumerable fine edges, which separate the rays into the prismatic colours,"—as I think it is better explained by the known refraction and refrangibility of rays passing through a transparent medium, and encountering different degrees of density, as may be illustrated by the following experiment: When a person suspends a glass globe in the sun's light, he will find that while he stands with his back to the sun, as the globe is moved higher or lower, he will see the prismatic colours in succession. The same is referable also to what we see take place on drops of rain, which constitute the rainbow, and the reason why we see it stationary is, the falling drops constantly replacing each other; which must continue to be the case, as long as the sun's rays fall upon the shower in the same direction. (See Mr. Partington's lecture, Vol. 1, page 214.)

One of the greatest triumphs of art that has taken place in this science, is the invention of Mr. Barton of the Mint, who has succeeded in giving to metallic plates the beautiful changing colours of mother of pearl, but for which he was partly indebted to Dr. Brewster, who had previously discovered that this appearance was not a property inherent in the body or substance of the pearl, but confined to the surface, and on examining the latter with a powerful microscope, he found it completely striated, or divided into parallel lines, which had the effect of decomposing the rays of light as they fell upon it. For the mode in which this was accomplished by Mr. Barton, see also Mr. P.'s lecture, at page 246 of the first volume.

I remain, Mr. Editor,
Your very obedient servant,
Leigh Street. G. H.

NATIONS UNACQUAINTED WITH THE USE OF FIRE.

THE inhabitants of the Martin Islands which were discovered in 1522, had no idea of fire. Never was astonishment greater than theirs, when they saw it, on the descent of Magellan, on one of their islands. At first they believed it to be a kind of animal, that fixed itself to, and fed upon wood. Some of them who approached too near being burnt, the rest were terrified, and durst only look upon it at a distance. They were afraid, they said, of being bit, or lest that dreadful animal should wound them with his violent respiration, for these were the first notions they formed of heat and flame. The inhabitants of the Philippine and Canary Islands were formerly as ignorant as those we have just been speaking of; and in the Isle Los Jordemis, the use of fire was lately unknown. The same is the state of several nations in America, particularly of the Amikowans, a people of South America.

S. H.

STAGE-COACH ACCIDENTS.

To the Editor of the Mechanics' Register.

SIR,—Would it not be advisable for the drivers of stages to observe the following suggestion, to prevent such dreadful accidents as we constantly hear of? viz. to have *iron spikes*, fixed firmly in the ground, at every house where the stage stops, with *iron chains* that could lock on to the wheel at a minute's notice, so as to prevent the horses from running away with the coach, while the coachman is not on the box. If you think this idea worthy of a place in your excellent Register, by inserting it, you will very much oblige

Your obedient Servant,

JUVENIS.

ANSWERS TO QUERIES.

ALGEBRAICAL INQUIRIES.

SIR,—I herewith send you solutions of the three Algebraic Questions proposed in the last Number; for the insertion of which I shall feel particularly obliged.—I am, Sir,

Your obedient servant,

D. H. K.

QUERY, No. 72, Page 416.

Let x = the worth of the cloak; £

Then by the question, As 12 months : £24 + x :: 8 months : 13 + x;

That is, $156 + 12x = 192 + 8x$;

Or, $12x - 8x = 192 - 156$.

Whence $4x = 36$; and x = £9 the Answer.

QUERY, No. 73, Page 416.

Put x = the No. of days B is in overtaking A,

and $6 \times 8 = 48$ miles A is distant from B, when B starts.

Whence $6x + 48 = 10x$;

Or, $48 = 4x$, and $x = 12$ days the Answer.

QUERY, No. 74, Page 416.

Let x = the height of the fracture,

and $48 - x$ = the length of the broken piece.

Then by 47th Eu. 1. $\overline{48-x}^2 - 17^2 = x^2$

By Involution, $2304 - 96x + x^2 - 289 = x^2$.

Whence $2304 - 289 = 96x$;

and x = 20 ft. 11 in. $1\frac{1}{2}$ pts. = the Answer.

D. H. K.

QUERY No. 13, page 79.

ANATOMICAL LEAVES.

To the Editor of the Mechanics' Register.

SIR,—The interesting letters on BOTANY which have lately appeared in your excellent Register, have brought to my mind an inquiry by Gmo. Henricus, which appeared some time ago, respecting the method of forming anatomical leaves, and which I intended to have promptly answered, had not a severe illness prevented me. It is with pleasure, I now give the information required, and I must first observe that they are produced by a mere *mechanical* operation, and that no *chemical* means are used.

The leaves are to be gathered when full grown and perfectly clear of spots or holes made by insects, as they will spoil the beauty of the work:—put them between the leaves of a large book, to absorb the moisture and make them tolerably dry, which will be in about six weeks;—when ready for use, take a thick quarto book, the edges of which are perfectly smooth, (one that is not often used will be best, as the leaves will not so easily divide), and set it upright so that it hardly opens; lay the back of the leaf on the top edge of the book, and with a clothes brush that has the bristles or hairs inserted perpendicularly in the wood, proceed to tap the upper surface of the leaf, hard enough to perforate it, frequently holding it up to the light that the progress of the work may be seen. The capillary tubes of the leaf, if it be sufficiently dried, will have become tough enough to resist a stroke of the brush, that will break away the finer part of the leaf. Cyphers and a variety of figures may be made, by cutting them out on paper and fixing them on with gum—this will shield that part from the action of the brush.

I know not, Mr. Editor, whether I have made myself understood; but I am ready to supply the deficiency, by shewing G. H. what I mean, by performing the experiment before him, whenever he pleases to call upon me, with some leaves properly prepared, or after the Midsummer holidays, when I hope to return from the country with a good stock of my own.

Yours truly,
JOHN REYNOLDS.
2, *Chadwell Street,*
St. John Street Road.

QUERY, No. 69. Page 367.

MUSICAL GLASSES.

To the Editor of the Mechanics' Register.

SIR,—The best method that I can suggest to your Correspondent, for constructing the *Harmonica,* is to get the glasses blown in a cylindrical shape, and to pour into them different portions of water, which will enable him to regulate them to any tuned *instrument;* and then to pass a wet finger lightly over the edge of the glasses, which will produce the sweetest tones. I have played "*God save the King,*" by the same plan, upon common tumblers. By inserting this, you will very much oblige,

Yours, &c.
JUVENIS.

QUERIES.

No. 81.

SIR,—Will any of your correspondents inform me, through the medium of your valuable Register, what is the cause of the smell of *hydrogen gas?*

Hackney. T. P. H.

No. 82.

I should feel obliged to any Correspondent who would inform me through the medium of your excellent Register, how to make an Æolian harp; what proportion the depth and breadth should bear to the length, what sort of strings should be used, where the pegs should be placed, whether there should be any board over or under the strings, &c.? Hoping this may have a corner in the Mechanics' Register, to which I wish success, I remain

Yours respectfully,
A CONSTANT SUBSCRIBER.

NOTICE.

The THIRD VOLUME of the LONDON MECHANICS' REGISTER being now completed, may be had of the Publishers, and of all other Booksellers, price 7s. 6d. in extra boards. The First Number of the FOURTH VOLUME will appear on Saturday next, and will be embellished with an elegantly engraved representation of the Telescopic appearance of the Moon, with other engravings, illustrative of Mr. WALLIS's admirable Lectures on Astronomy. The copious and accurate report of the first Lecture, with the beautiful engraving of the Lecturer's magnificent Tellurian, have occasioned so extraordinary a demand for the last Number, that we have been obliged to make a large addition to our usual extensive impression; and as the remainder of the Lectures will be detailed with equal minuteness, and illustrated in a similar manner, the course will comprise a complete elucidation of all the most striking phenomena of this important science.

TO CORRESPONDENTS.

JUVENIS has evidently misunderstood the remark in our last number. Our meaning was, that as the same offer had been previously made by another Correspondent, and accepted by us, it was unnecessary for JUVENIS to transmit his communications on the subject in question.

Answers to other Correspondents next week.

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